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WITH INDEXES
Supplement 12

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AERONAUTICAL ENGINEERING

A Special Bibliography

Supplement 12

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in November 1971 in

- *Scientific and Technical Aerospace Reports (STAR)*
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INTRODUCTION

Under the terms of an interagency agreement with the Federal Aviation Administration this publication has been prepared by the National Aeronautics and Space Administration for the joint use of both agencies and the scientific and technical community concerned with the field of aeronautical engineering.

This supplement to *Aeronautical Engineering—A Special Bibliography* (NASA SP-7037) lists 296 reports, journal articles, and other documents originally announced in November 1971 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*. For previous bibliographies in this series, see inside of front cover.

The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles.

Each entry in the bibliography consists of a standard bibliographic citation accompanied by an abstract. The listing of the entries is arranged in two major sections, *IAA Entries* and *STAR Entries* in that order. The citations and abstracts are reproduced exactly as they appeared originally in *IAA* or *STAR*, including the original accession numbers from the respective announcement journals. This procedure, which saves time and money, accounts for the slight variation in citation appearances.

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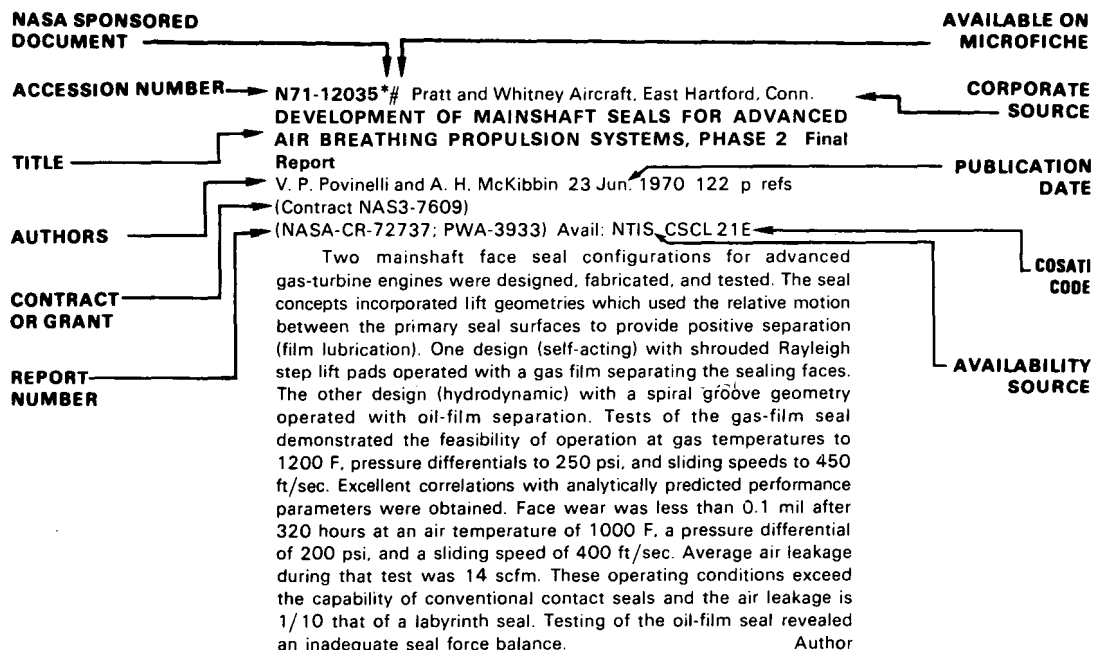
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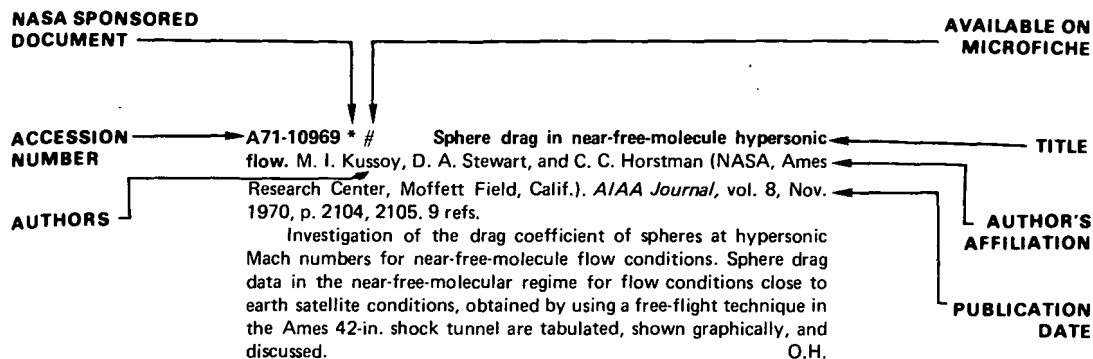
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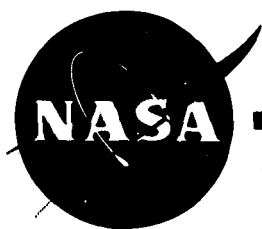
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AERONAUTICAL ENGINEERING

A Special Bibliography (Suppl. 12) DECEMBER 1971

IAA ENTRIES

A71-40010 'Turbulence' and vortex motions. Dietrich Küchemann (Royal Aircraft Establishment, Farnborough, Hants., England). *Zeitschrift für Flugwissenschaften*, vol. 19, Aug.-Sept. 1971, p. 305-308. 16 refs.

In an attempt to find some concepts which might bring some order into what are usually described as turbulent motions, some thoughts are presented, which might lead to an interpretation of some of these motions in fluids of small viscosity in terms of inviscid flows involving vortex sheets and rolled-up vortex cores. (Author)

A71-40081 Flow in the near wake. I. Iu. Brailovskaia (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR). (*Akademiia Nauk SSSR, Doklady*, vol. 197, Mar. 21, 1971, p. 542-544.) *Soviet Physics - Doklady*, vol. 16, Sept. 1971, p. 197-199. Translation.

A numerical solution of Navier-Stokes equations for a compressible viscous gas is obtained in the near-wake region behind the perpendicular (to the flow surface) trailing face of a plate in supersonic flow. The velocity, density, temperature, and boundary-layer parameters for the oncoming flow are known. The Navier-Stokes equations for the region of interest consist of two equations of motion, an energy equation, and a continuity equation. Pressure, density, and temperature are related by the equation of state. The viscosity and thermal conductivity coefficients are power functions of temperature. The boundary value problem for the region with specified boundary conditions was solved numerically by the finite difference method. The results for nine different cases of specified initial parameters are given graphically in the form of characteristic streamlines and pressure profiles. T.M.

A71-40112 Evaluation of man/machine interface problems in ATC systems. J. Nokes and J. T. Boardman (Liverpool, University, Liverpool, England). In: Displays; Institution of Electrical Engineers, Conference, Loughborough University of Technology, Loughborough, Leics., England, September 7-10, 1971, Proceedings. London, Institution of Electrical Engineers (IEE Conference Publication No. 80); 1971, p. 69-75.

Description of a fast-time simulation model of an ATC system in which a large variety of ATC ground organizations, including both

personnel and equipment, can be represented with a high degree of flexibility in the specification of any desired system. The simulation model is a set of programs, written for a general-purpose digital computer, which is a topological representation of the actual ATC complex. These computer programs require inputs in the form of parameters controlling the system, a description of the ATC centers and equipment, the constraints and variations on procedures, and the traffic sample providing a series of specific inputs for the model which will initiate sequences of workload demands. The concept used in the simulation model is that the system is described in terms of 'active points' (e.g., men and machine elements) with communication links between them. A.B.K.

A71-40113 Display of information in the aircraft cockpit. J. M. Rolfe and J. W. Chappelow (RAF, Institute of Aviation Medicine, Farnborough, Hants., England). In: Displays; Institution of Electrical Engineers, Conference, Loughborough University of Technology, Loughborough, Leics., England, September 7-10, 1971, Proceedings. London, Institution of Electrical Engineers (IEE Conference Publication No. 80); 1971, p. 77-82.

Discussion of ways of providing pilots with necessary information without unduly complicating the information display. The need to provide the pilot with information from a number of sources which has already been processed to a certain extent is stressed, citing the head-up display as a good example of what can be done in this respect. The cathode ray tube is also characterized as offering great potential in relieving pilots of unnecessary data interpretation labor. A.B.K.

A71-40114 The evaluation of touch displays for air traffic control tasks. V. D. Hopkin (RAF, Institute of Aviation Medicine, Farnborough, Hants., England). In: Displays; Institution of Electrical Engineers, Conference, Loughborough University of Technology, Loughborough, Leics., England, September 7-10, 1971, Proceedings. London, Institution of Electrical Engineers (IEE Conference Publication No. 80); 1971, p. 83-90. 9 refs.

Results of tests comparing the performance of operators of touch displays with that of operators of tabular traffic displays using a conventional keyboard. It is found that, in comparison with a display using a conventional keyboard, the touch display is quicker and easier to learn and use as a data entry device, requires no selection procedure for operators, is silent, avoids most search and coding problems, can be adapted for programmed instruction, and is preferred by its users. Moreover, the touch display is superior in both system-paced and operator-paced tasks, especially when programs permit the entry of blocks of data with a single touch. A.B.K.

A71-40118 Computer-derived alphanumeric information on air traffic control displays. V. D. Hopkin and R. A. Edenborough (RAF, Institute of Aviation Medicine, Farnborough, Hants., England). In: Displays; Institution of Electrical Engineers, Conference, Loughborough University of Technology, Loughborough, Leics., England, September 7-10, 1971, Proceedings. London, Institution of Electrical Engineers (IEE

Conference Publication No. 80), 1971, p. 109-116. 5 refs.

Examination of the feasibility and effectiveness of an approach to air traffic control involving the use of alphanumeric labels in a series of experiments in which the work of an air traffic controller was simulated. These experiments dealt with various conditions of labeling, a comparison of various stages in the introduction of labeling, the use of call signs for addressing aircraft, the overlapping of labels, and means of overcoming the problem of overlapping. The most consistent finding from this series of experiments is that subjects are favorably disposed to radar labels, and that they prefer labels which give the most information of immediate use without the need to cross-refer to other data. A.B.K.

A71-40119 **The incidence and effects at the man-computer of failure to optimise the display.** R. G. Green and R. A. Edenborough (RAF, Institute of Aviation Medicine, Farnborough, Hants., England). In: Displays; Institution of Electrical Engineers, Conference, Loughborough University of Technology, Loughborough, Leics., England, September 7-10, 1971, Proceedings. London, Institution of Electrical Engineers (IEE Conference Publication No. 80), 1971, p. 117-123. 6 refs.

Application of a field technique and a laboratory approach in a study of the effects of faults and delays in the air traffic control system on operator performance. The field technique chosen was that of a structured interview designed to discover how the operator felt about increasing automation in general, without too much emphasis being placed on faults and delays. The laboratory technique was designed to uncover shorter-term performance effects which might be induced by the occurrence of delays. The effect of machine pacing on the working rate in both the questionnaire and the laboratory work is noted. A.B.K.

A71-40128 **H.A.P.P.I. - Height and plan position indicator.** R. W. Elbourn (Plessey Co., Ltd., Addlestone, Surrey, England). In: Displays; Institution of Electrical Engineers, Conference, Loughborough University of Technology, Loughborough, Leics., England, September 7-10, 1971, Proceedings. London, Institution of Electrical Engineers (IEE Conference Publication No. 80), 1971, p. 239-248.

Description of an air traffic controller's display combining the functions of Primary and Secondary Surveillance Radars in providing height information and lateral information on aircraft in a unified spatial form. The composite picture seen on this display is an orthographic projection having a pictorial property that conveys an immediate general impression in three dimensions. Line-drawings illustrating the design and operation of this display are given. V.Z.

A71-40131 **Head-up display systems in modern aircraft.** J. H. Sones (Smiths Industries, Ltd., Cheltenham, Glos., England). In: Displays; Institution of Electrical Engineers, Conference, Loughborough University of Technology, Loughborough, Leics., England, September 7-10, 1971, Proceedings. London, Institution of Electrical Engineers (IEE Conference Publication No. 80), 1971, p. 263-270.

A Head Up Display (HUD) is a means of providing information to the pilot while he is looking at the outside world ahead of his aircraft. The information appears focussed at infinity and within the pilot's normal field of view. The history of HUD systems is discussed together with the principles of operation, and civil HUD systems. Simulator studies are conducted to determine a suitable set of standard symbols for the HUD. The simulators used are of the normal type for aircraft simulator studies with the addition of the HUD. G.R.

A71-40134 **Display systems for vertical take-off transport aircraft.** Barry C. Francis (Control Systems, Ltd.). In: Displays;

Institution of Electrical Engineers, Conference, Loughborough University of Technology, Loughborough, Leics., England, September 7-10, 1971, Proceedings. London, Institution of Electrical Engineers (IEE Conference Publication No. 80), 1971, p. 301-305.

A V/STOL simulator study, carried out on the Hatfield fixed base simulation facility, is described in which the operational requirements of an aircraft flying profiles anywhere between the very shallow angles typical of conventional aircraft up to the limiting case vertical ascent and descent were investigated. A comparison of the head-up display VTOL and STOL studies indicates that properly processed director information need not be intimately related to quantitative information. A thorough assessment of the display concept showed that it was possible to provide the pilot of even a very complex aircraft with much of the information in a form that he would require to perform an accurate and safe landing. V.P.

A71-40137 **Avionics displays - With particular reference to area navigation systems.** P. M. Giles (Computing Devices Co., Ltd.). In: Displays; Institution of Electrical Engineers, Conference, Loughborough University of Technology, Loughborough, Leics., England, September 7-10, 1971, Proceedings. London, Institution of Electrical Engineers (IEE Conference Publication No. 80), 1971, p. 357-362. 5 refs.

An avionic display system currently under development is described which combines electronic and mechanical technology and features processed information and raw data in several modes. Navigational geographic orientation is projected in the form of colored map charts from a film strip onto the phosphor of a CRT. The compass rose, bearing, and track pointers are either projected from the same rear port of the CRT or, alternatively, generated by the CRT electron beam. CRT displays of radar and symbology are written by the electron beam on the phosphor. Details of film transport, navigational overlays, and dynamic information overlays are discussed. T.M.

A71-40167 # **Synthesis of tire equations for use in shimmy and other dynamic studies.** L. C. Rogers and H. K. Brewer (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). *Journal of Aircraft*, vol. 8, Sept. 1971, p. 689-697. 14 refs.

A system of transfer functions relating the cornering force and aligning torque of a rolling pneumatic tire to its yaw angle and lateral displacement are developed from experimental and theoretical frequency response curves. These transfer functions consist of ratios of polynomials in the Laplacian variable s , which lead to a system of linear constant coefficient differential equations. The resulting equations have the advantage of both simplicity and accuracy and are ideally suited for use in dynamical analysis such as the study of wheel shimmy phenomena. These differential equations, along with the corresponding experimental frequency response curves, are compared with those derived from the widely used Moreland tire theory. This comparison reveals a number of inadequacies in the Moreland theory. (Author)

A71-40168 # **Position of the thrust line and longitudinal stability.** Amnon Katz. *Journal of Aircraft*, vol. 8, Sept. 1971, p. 738, 739.

The general assumption that phugoid motion occurs at a constant angle of attack is shown to be true only as long as the thrust line is not appreciably displaced from the aircraft center of gravity. Expressions for the frequency and damping of the phugoid are derived for the case where a displacement of the thrust line does occur. V.P.

A71-40169 # **Vortex flow over helicopter rotor tips.** John D. Hoffman and Henry R. Velkoff (Ohio State University,

Columbus, Ohio). *Journal of Aircraft*, vol. 8, Sept. 1971, p. 739, 740. Army-sponsored research.

Study of the flow over square tips, using a flow visualization technique whereby ammonia vapor was expelled for a short time from a network of orifices in the tip and carried by the boundary-layer flow over a diazonium salt solution which was sprayed over the tip. The ammonia vapor reacted with the diazonium salt solution and left dark traces on the surface indicative of the local flow direction. It was found that the point at which the flow direction suddenly changes, i.e., the point of vortex inception, was a strong function of blade pitch angle. The flow patterns that were found to exist on the rotor blade tips may also exist on the tips of regular wings. F.R.L.

A71-40170 # Real gas effects in compressors for aircraft gas turbines. Allen E. Fuhs (U.S. Naval Postgraduate School, Monterey, Calif.). *Journal of Aircraft*, vol. 8, Sept. 1971, p. 740, 741.

Discussion of the effects of the trend to higher pressure ratios in aircraft gas turbines, which leads to higher exit temperatures from the compressor. The vibrational degrees of freedom of oxygen begin to be thermally excited resulting in a decrease of the ratio of specific heats. Some aspects of compressor technology are considered, and it is shown that in order to understand combustion kinetics from a fundamental point of view, the presence of vibrationally excited O₂ in the combustor inlet is important. F.R.L.

A71-40172 # Subsonic similarity rule for jet-flapped airfoil. Sheldon Elzweig (Advanced Technology Laboratories, Inc., Jericho, N.Y.). *Journal of Aircraft*, vol. 8, Sept. 1971, p. 744, 745. Research supported by the General Dynamics Corp.

Extension of an earlier analysis (Spence, 1956), by means of similarity transformations, to the case of a two-dimensional, jet-flapped, symmetric wing in subsonic flow. The analysis assumes that the flow inside the jet is irrotational and bounded by vortex sheets across which it is prevented from mixing with the main stream, and that the jet is infinitely thin, but possesses finite momentum. F.R.L.

A71-40173 # Downwash correction for a two-dimensional finite wing. Nathan Ness (West Virginia University, Morgantown, W. Va.). *Journal of Aircraft*, vol. 8, Sept. 1971, p. 745, 746. Contract No. N 00014-68-A-0512.

Demonstration that the true two-dimensional flow over the two-dimensional finite wing can be found without the need to correct experimentally for the downwash provided the pressure distribution over the section is known from the test data. The method proposed applies to airfoil sections of any shape with or without blowing (or suction) provided the spanwise flow at the section where the experimental pressure distribution is obtained is negligible. It is also assumed that the contribution of the flowing (or suction) momentum to the lift is negligible. F.R.L.

A71-40319 # A note on the calculation of torsional natural frequencies of branch systems. A. C. Gilbert. *American Society of Mechanical Engineers, Vibrations Conference and International Design Automation Conference, Toronto, Canada, Sept. 8-10, 1971, Paper 71-Vibr-83*. 5 p. 5 refs. Members, \$1.00; nonmembers, \$3.00.

An adoption of matrix techniques is proposed as a method for the solution of torsional natural frequencies in a branch or geared shaft system. Both fundamental and higher mode shapes and frequencies are produced by a comparatively rapid and straightforward technique. The method is illustrated by a numerical example of a coupled turbine and reciprocating engine system driving a common propeller. (Author).

A71-40325 * # Transient flexible-rotor dynamics analysis. I. F. A. Shen (North American Rockwell Corp., Rocketdyne Div.,

Canoga Park, Calif.). *American Society of Mechanical Engineers, Vibrations Conference and International Design Automation Conference, Toronto, Canada, Sept. 8-10, 1971, Paper 71-Vibr-92*. 8 p. Members, \$1.00; nonmembers, \$3.00. Contract No. NAS 3-13219.

A mathematical formulation for the analysis of the transient and steady-state flexible rotor dynamics has been developed. Newton's Laws of Dynamics as used here were found to be more direct and efficient than the alternate Lagrange energy approach. In addition, the influence coefficient technique, including both bending and shear flexibility of a rotor, is applied to correlate the load deflection effects between various rotor stations. The mathematical formulation considers the general nonaxisymmetric and nonsynchronous rotor motion which may result from the included in-phase and out-of-phase stiffness and damping functions at all bearing and rotor stations. Other rotor dynamic parameters considered are the rotor masses and mass moments of inertia and their eccentricities and misalignments. The effects of rotor drive and dissipative torque and the interaction between torsional and transverse motion are also included. (Author)

A71-40351 Noise and aircrew effectiveness. William R. Pierson (Lockheed-California Co., Burbank, Calif.). *Aerospace Medicine*, vol. 42, Aug. 1971, p. 861-864. 15 refs.

Aircrew effectiveness was equated with the ability to interpret display data (perceptual judgments) and to make correct decisions when the choices are few in number (intellectual judgments). Eight hours' exposure to 100 dB(A) aircraft cabin noise had no effect on perceptual judgment ability or on the time required for intellectual judgment. During the second 4 hr of the 8-hr exposure there was a significant increase in the number of errors committed in the intellectual judgment task. A significant shift in hearing acuity threshold occurred, but normal hearing was recovered within 48 hr. M.M.

A71-40359 Epidemiology of USAF spatial disorientation aircraft accidents, 1 Jan 1958-31 Dec 1968. Ferdinand Barnum and Robert H. Bonner (USAF, Directorate of Aerospace Safety, Norton AFB, Calif.). *Aerospace Medicine*, vol. 42, Aug. 1971, p. 896-898. 6 refs.

Demonstration that spatial disorientation is still a significant flight safety problem. It is indicated that 192 mostly highly qualified USAF pilots lost their lives because of disorientation during the decade from 1958 to 1968 and that age, experience and phase of flight contributed little to these accidents. Operational analysis of training, of flight environment and of indoctrination programs is suggested to remedy this situation. V.Z.

A71-40381 Free flight model testing in a Ludwieg-tube at high supersonic speeds. H. Grauer-Carstensen (Aerodynamische Versuchsanstalt, Göttingen, West Germany). In: *ICIASF '71; International Congress on Instrumentation in Aerospace Simulation Facilities, Rhode-Saint-Genèse, Belgium, June 21-23, 1971, Record*. New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p. 9-13.

Description of a model launching technique for free flight testing in wind tunnels. It is to be used in a Ludwieg-tube operating in a Mach-number range from 3 to 12. Due to its performance and running time, a Ludwieg-tube is especially suited for free flight testing. The launching device and the recording setup are presented, and particulars are discussed regarding the choice and realization of optimum launching data. (Author)

A71-40392 An integrated facility for the simulation of some non-linear flight dynamic problems. I. M. Titchener and B. E. Pecover (Royal Aircraft Establishment, Farnborough, Hants., England). In: *ICIASF '71; International Congress on Instrumentation*

in Aerospace Simulation Facilities, Rhode-Saint-Genèse, Belgium, June 21-23, 1971, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p. 105-110. 14 refs.

This paper reviews an advanced technique of simulation which dispenses with detailed mathematical representations by substituting a slaved aircraft model and wind tunnel. These constitute an analogue function generator of the required out of balance aerodynamic data. This information is transferred directly to a computer which simultaneously processes the equations of motion of the flight vehicle, using the solution to command the orientation of the model to the airflow. The technique gives good accuracy and results in substantial overall economies in the simulation of complex flight dynamic phenomena. A description is given of the control system for the model attitude gear and for the operation of the wind tunnel at continuously variable Mach number. Special modes of automatic operation of the facility are shown and an associated analysis system is discussed. (Author)

A71-40393 **The direct measurement of fluctuating aerodynamic forces experienced by an effectively stationary body spanning a wind tunnel.** R. S. Hill and B. Pennington (Newcastle-upon-Tyne, University, Newcastle-upon-Tyne, England). In: ICIASF '71; International Congress on Instrumentation in Aerospace Simulation Facilities, Rhode-Saint-Genèse, Belgium, June 21-23, 1971, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p. 111-118. 5 refs.

The technique described was developed in order to measure directly the amplitude and spectral distribution of the total A.C. component of the aerodynamic force experienced by a single cylinder of circular cross section both in isolation and as a member of a tube bank. It can, however, be adapted fairly easily to make similar measurements on any body of aerodynamic interest which can be fixed to a support spanning a wind tunnel working section. Furthermore it is a fairly straightforward extension to measure also the mean D.C. component of the total force. (Author)

A71-40395 **Density measurement in aerodynamic flows by an electron beam probe.** Serge Lewy (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). In: ICIASF '71; International Congress on Instrumentation in Aerospace Simulation Facilities, Rhode-Saint-Genèse, Belgium, June 21-23, 1971, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p. 125-135. 14 refs.

ONERA has equipped a small continuous hypersonic wind tunnel in view of exploring the possibility of electron beam probing, its limitations and the precision to be expected. The experimental set-up is described. The results presented concern the study of gas densities. In the simplest tests a flow section is visualized by translation of the electron beam. The quantitative reduction of the views obtained is analyzed. Within the range of densities explored, which are rather high for this method, several secondary phenomena should be considered if accurate measurements are to be obtained. The proposed theoretical model is applied to the study of isobaric boundary layers. (Author)

A71-40397 **Measurement of the turbulence degree in gas flows using a laser velocimeter.** H. D. vom Stein and H. J. Pfeifer (Institut Franco-Allemand de Recherches, Saint-Louis, Haut-Rhin, France). In: ICIASF '71; International Congress on Instrumentation in Aerospace Simulation Facilities, Rhode-Saint-Genèse, Belgium, June 21-23, 1971, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p. 148-151. 5 refs.

It is the purpose of this paper to describe the application of the Doppler-difference velocimeter in turbulence diagnostics. A jet of a subsonic wind tunnel was used as test flow, containing natural

contaminations such as dust particles, being permanently present in the air, as scattering centers for the laser light. A short comparison with other techniques will be executed. (Author)

A71-40399 **Application of dual scatter, laser, Doppler velocimeters for wind tunnel measurements.** A. E. Lennert, F. H. Smith, Jr., and H. T. Kalb (ARO, Inc., Arnold Air Force Station, Tenn.). In: ICIASF '71; International Congress on Instrumentation in Aerospace Simulation Facilities, Rhode-Saint-Genèse, Belgium, June 21-23, 1971, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p. 157-167. 12 refs.

A dual scatter, both forward and back scatter, laser Doppler velocimeter, in addition to a direct readout, system is briefly described. The characteristics of the dual scatter system are such that no artificial seeding of flow is required to effect the measurements. With minor modifications and improvements, the dual scatter, both forward and back scatter, LDV system will supplant conventional measuring devices, i.e., pitot tubes, rakes, etc., and will be an operational instrument. In support of this conclusion, the application of the instrument to actual wind tunnel measurements including calibration of the one-foot transonic wind tunnel; flow field measurements of a simulated helicopter downwash in addition to flow field mapping across a high lift wing section are presented and discussed. (Author)

A71-40434 **Infrared and thermal evaluation of a phased array antenna.** R. J. Joachim and M. J. Pitasi (Raytheon Co., Missiles Systems Div., Bedford, Mass.). (American Society for Nondestructive Testing, Spring Conference, Los Angeles, Calif., Mar. 9-12, 1970.) *Materials Evaluation*, vol. 29, Sept. 1971, p. 193-198, 204. Contract No. AF 33(615)-67-C-1108.

A 30-in. diam phased array radar antenna, designed for advanced tactical aircraft, incorporates 4000 separate heat dissipating elements. The heat dissipation of each element is nonuniform and varies with time, radar operating mode and location within the array. Approximately 4000 small passages between the elements were available for cooling. A major task associated with the antenna design was to distribute cooling air to these elements in a manner which would maintain the steady-state operating temperature difference between the interior (ferrite rod) of any two elements at less than 18 deg F (10 deg C) during rooftop tests. Steady-state outer surface temperature maps of the elements, for various operating modes, were obtained with a Polaroid camera attached to the video output of an infrared television system. Supplementing these temperature maps, a special microwave test fixture was used to determine the internal temperature rise of the element as a function of phase shift. Using the data obtained from the infrared television system and microwave test figure, the cooling distribution air was adjusted by systematically decreasing the available cooling passages until the maximum steady-state operating temperature difference between ferrite rods was reduced from 30 deg F to 17 deg F. (Author)

A71-40441 **Automated electrical harness manufacturing.** John W. Tarbox (Hughes Aircraft Co., Oceanside, Calif.) and Paul W. Mercer (Boeing Co., Commercial Airplane Group, Seattle, Wash.). In: National Electronic Packaging and Production Conference, Anaheim, Calif., February 9-11, 1971 and New York, N.Y., June 15-17, 1971, Proceedings of the Technical Program. Chicago, Industrial and Scientific Conference Management, Inc., 1971, p. 213-220.

Some of the problems that arose in the first six months of operation of an automated harness laying machine, representing a start toward automating the process of automated electrical wire harness manufacture, are discussed, along with obtained performance results and expectations for the future. At publication time, nine Boeing 747 harnesses were programmed and formed for production

airplanes. New wire bundles will be added to the system at a rate of about two per week to reach a predicted machine capacity of 70 harnesses on a two-shift basis. By year's end, enough data will be available to define a second generation machine. Primary benefits relate so far to tangible labor costs such as search, handling, and routing on board and off. Other beneficial areas expected to become more important later on include a significant reduction in the time required to build a harness and enhanced reliability of assembly.

M.V.E.

A71-40482 Aircraft wake turbulence and its detection; Proceedings of the Symposium, Seattle, Wash., September 1-3, 1970. Symposium sponsored by the Boeing Scientific Research Laboratories and the U.S. Air Force. Edited by J. H. Olsen, Arnold Goldberg (Boeing Scientific Research Laboratories, Seattle, Wash.), and Milton Rogers (USAF, Office of Scientific Research, Arlington, Va.). New York, Plenum Press, 1971. 599 p. \$29.50.

The articles cover the properties of wakes, including their formation, stability, and decay, and provide data on interactions between wakes and following aircraft as well as experimental methods of observing wake properties. A wide variety of topics is discussed, ranging from fundamentals of vortex motion to the possible methods for reducing the hazards associated with an encounter by a following aircraft. A panel discussion and author and subject indexes are included.

A.B.K.

A71-40483 Aircraft wakes - A new look at a classical problem. W. L. Shields (USAF, Washington, D.C.). In: Aircraft wake turbulence and its detection; Proceedings of the Symposium, Seattle, Wash., September 1-3, 1970. Symposium sponsored by the Boeing Scientific Research Laboratories and the U.S. Air Force. Edited by J. H. Olsen, Arnold Goldberg, and Milton Rogers. New York, Plenum Press, 1971, p. 1-8. 20 refs.

Development of a frame of reference for a symposium on aircraft wake turbulence. The history of aerodynamic vortex research is reviewed, noting a pattern of unfolding complexity, as exemplified in the case of the Kármán vortex street and the phenomenon of the edgetone. The genesis of the AFOSR (Air Force Office of Scientific Research) wake turbulence research program is described. Some of the challenging research opportunities contained within the wake problem are briefly commented on.

A.B.K.

A71-40486 Transport of a vortex wake in a stably stratified atmosphere. I. H. Tombach (Meteorology Research, Inc., Altadena, Calif.). In: Aircraft wake turbulence and its detection; Proceedings of the Symposium, Seattle, Wash., September 1-3, 1970.

Symposium sponsored by the Boeing Scientific Research Laboratories and the U.S. Air Force. Edited by J. H. Olsen, Arnold Goldberg, and Milton Rogers. New York, Plenum Press, 1971, p. 41-56. 11 refs. USAF-supported research.

Development of a simplified approximate model of the dominant effects of atmospheric stability on the transport of a trailing vortex wake. In this study the wake behavior is modeled analytically as a pair of infinite vortices in an inviscid, compressible, stably stratified atmosphere with entrainment characterized by a single parameter related to the difference between the density in a particular region of the wake and that external to the wake. It is found that the motion of such a vortex system is governed by a parameter Q which depends on the initial circulation and vortex spacing, on the atmospheric stability, and on the entrainment parameter. The nature of the transport follows one of two patterns, depending on whether Q is less than or greater than a certain critical value. If Q is less than the critical value, the circulation decreases more rapidly than the momentum and the vortices separate as they descend to an equilibrium level. If Q is greater than the critical value, the momentum of the vortices decreases more rapidly than the circulation and, after an initial period of slow divergence, the vortices

attempt to converge as they descend. In both cases, the descent takes place in a well-defined characteristic time which depends solely on the atmospheric density gradient.

A.B.K.

A71-40488 Sub-scale modeling of aircraft trailing vortices. Robert L. Kiang (Stanford Research Institute, Menlo Park, Calif.). In: Aircraft wake turbulence and its detection; Proceedings of the Symposium, Seattle, Wash., September 1-3, 1970.

Symposium sponsored by the Boeing Scientific Research Laboratories and the U.S. Air Force. Edited by J. H. Olsen, Arnold Goldberg, and Milton Rogers. New York, Plenum Press, 1971, p. 81-95.

Description of a pilot study of aircraft trailing vortices using a subscale model in a controllable laboratory environment. The essential feature of this laboratory facility is to have a vortex-generating wing moving along a pair of elevated rails so that the vortices shed by the wing remain relatively fixed with respect to ground-based instrumentation and can be observed and measured throughout their entire life-span. The vortices are rendered visible to two methods: by smoke traces and by drifting soap bubbles. A 16-mm movie camera is used to record the visible vortices. The smoke-traced vortices give better qualitative pictures, but the soap-bubble pictures are more suitable for quantitative studies. Hot-wire anemometer probes are also used to study the turbulence nature of the vortices.

A.B.K.

A71-40489 The utility of Doppler radar in the study of aircraft wing-tip vortices. Calvin C. Easterbrook and William W. Joss (Cornell Aeronautical Laboratory, Inc., Buffalo, N.Y.). In: Aircraft wake turbulence and its detection; Proceedings of the Symposium, Seattle, Wash., September 1-3, 1970.

Symposium sponsored by the Boeing Scientific Research Laboratories and the U.S. Air Force. Edited by J. H. Olsen, Arnold Goldberg, and Milton Rogers. New York, Plenum Press, 1971, p. 97-112.

The feasibility of utilizing a special purpose Doppler radar to investigate air motions in aircraft wakes is explored and tested. Two similar experimental methods are undertaken to investigate the potential value of the Doppler radar approach. The first method involves injection of radar reflecting chaff into the wing-tip vortex of an aircraft in flight, and subsequently recording the Doppler spectrum of the return from the chaff packet as obtained by the radar looking normal to the flight path. The second method consists of Doppler measurements in the wake behind aircraft on the approach to an airport during snow conditions, where natural snow crystals and flakes assume the role of radar reflecting tracers of air motion. The power spectra derived from both techniques reflect the distribution of velocities of scatterers (chaff elements or snow crystals) in the direction of the radar, weighted by the spatial distribution of the scatterers contained in the radar sensitive volume.

(Author)

A71-40490 * Application of laser Doppler systems to vortex measurement and detection. R. M. Huffaker (NASA, Marshall Space Flight Center, Huntsville, Ala.), A. V. Jelalian, W. H. Keene, and C. M. Sonnenschein (Raytheon Co., Sudbury, Mass.). In: Aircraft wake turbulence and its detection; Proceedings of the Symposium, Seattle, Wash., September 1-3, 1970.

Symposium sponsored by the Boeing Scientific Research Laboratories and the U.S. Air Force. Edited by J. H. Olsen, Arnold Goldberg, and Milton Rogers. New York, Plenum Press, 1971, p. 113-124.

Description of a laser Doppler system for the measurement of atmospheric wind velocity and turbulence. The system utilizes the Doppler frequency shift undergone by a beam of radiation when scattered by particles suspended in the flows. From the measurement of this difference frequency between the scattered and the reference laser light and knowledge of the geometry of the system, the velocity is directly determined. A three-dimensional version of the system, developed for wind-tunnel and jet-type flow studies, is described, as

well as a one-dimensional research unit. Comparisons of cup and hot-wire anemometer data with data obtained by the laser Doppler system regarding the time history of the wind velocity and the statistical properties of the wind velocity fluctuation are presented. The results of application of the Doppler system to the problem of detecting the presence of an aircraft trailing vortex are also cited.

A.B.K.

A71-40491 An analysis of flight measurements in the wake of a jet transport aircraft. B. Caiger and D. G. Gould (National Aeronautical Establishment, Ottawa, Canada). In: Aircraft wake turbulence and its detection; Proceedings of the Symposium, Seattle, Wash., September 1-3, 1970. Symposium sponsored by the Boeing Scientific Research Laboratories and the U.S. Air Force. Edited by J. H. Olsen, Arnold Goldberg, and Milton Rogers. New York, Plenum Press, 1971, p. 125-136. 5 refs.

Peak velocity vectors measured in the transverse plane of the wake of a Convair 880 aircraft were found to be four times as high as anticipated. The peak velocities are shown to occur in small intense vortices which are separate from the main tip vortices. These exist up to 30 seconds after generation. The main tip vortices are shown to have a core size which is roughly of the size anticipated but whose diameter does not increase significantly up to 30 seconds after generation. (Author)

A71-40492 Vortex control. M. T. Landahl and S. E. Widnall (MIT, Cambridge, Mass.). In: Aircraft wake turbulence and its detection; Proceedings of the Symposium, Seattle, Wash., September 1-3, 1970. Symposium sponsored by the Boeing Scientific Research Laboratories and the U.S. Air Force. Edited by J. H. Olsen, Arnold Goldberg, and Milton Rogers. New York, Plenum Press, 1971, p. 137-155. 18 refs. Contracts No. AF 49(638)-1622; No. AF 44(620)-69-C-0900.

The fluid dynamical aspects of the control of free vortices emanating from the wing or other parts of a flight vehicle are reviewed. Simple calculations based on slender-body theory are used to demonstrate the importance of controlling the strength, position and core stability and thickness of such vortices. From the equations describing vortex motion, conclusions are drawn as to how vortex properties can be influenced. In particular, a one-dimensional flow model for the vortex core flow is explored to identify the factors important in the determination of core thickness and stability. Simple energy arguments are used to clarify the phenomenon of vortex bursting and to draw conclusions as to what can be done to prevent or induce bursting. Examples of engineering applications of vortex control are given. In particular, recent advanced control schemes employed for the Saab A37 'Viggen' are described. (Author)

A71-40493 * The effect of a drooped wing tip on its trailing vortex system. Barnes W. McCormick and Raghuvveera Padakannaya (Pennsylvania State University, University Park, Pa.). In: Aircraft wake turbulence and its detection; Proceedings of the Symposium, Seattle, Wash., September 1-3, 1970. Symposium sponsored by the Boeing Scientific Research Laboratories and the U.S. Air Force. Edited by J. H. Olsen, Arnold Goldberg, and Milton Rogers. New York, Plenum Press, 1971, p. 157-169. 6 refs. Grant No. NGR-39-009-111.

Study of the effect of a drooped wing tip on the structure and position of its trailing vortex. Spanwise load distributions determined by vortex lattice theory show that the stronger vortex moves from the tip of the wing to the hinge of the drooped tip as the droop angle increases. Experimental results on model wings are given which present the strength and the induced velocity profiles of the rolled-up vortex as a function of tip geometry. These results confirm, at least qualitatively, the analytical prediction. It is concluded that a droop angle of approximately 90 deg is optimum and results in a maximum induced velocity which is half that produced by a plane wing. (Author)

A71-40494 Some work at the Royal Aircraft Establishment on the behaviour of vortex wakes. P. L. Bisgood, R. L. Maltby, and F. W. Dee (Royal Aircraft Establishment, Bedford, England). In: Aircraft wake turbulence and its detection; Proceedings of the Symposium, Seattle, Wash., September 1-3, 1970.

Symposium sponsored by the Boeing Scientific Research Laboratories and the U.S. Air Force. Edited by J. H. Olsen, Arnold Goldberg, and Milton Rogers. New York, Plenum Press, 1971, p. 171-206. 8 refs.

The paper reviews the work done at the Royal Aircraft Establishment on the behavior of vortex wakes. Measurements of the development of wakes behind straight and swept wings are described. The results of observations on the formation of loops in a vortex wake, on the behavior of the wakes close to the ground and on the development of the wake from a slender wing are given in some detail. (Author)

A71-40495 Span loading and formation of wake. Peter F. Jordan (Martin Marietta Corp., Research Institute for Advanced Studies, Baltimore, Md.). In: Aircraft wake turbulence and its detection; Proceedings of the Symposium, Seattle, Wash., September 1-3, 1970. Symposium sponsored by the Boeing Scientific Research Laboratories and the U.S. Air Force. Edited by J. H. Olsen, Arnold Goldberg, and Milton Rogers. New York, Plenum Press, 1971, p. 207-227. 13 refs. Contract No. AF 44(620)-69-C-0096.

Classical analyses of aircraft wake formation assume that the wing span loading is (essentially) elliptic, and that in consequence the wake starts out being (essentially) flat. This assumption is incorrect: actual span loadings contain a logarithmic term, and in consequence there is an infinite upwash directly behind the wing just inside the wing tips. This explains why the aircraft wake rolls up faster than the classical analyses predict. (Author)

A71-40496 * An experimental investigation of trailing vortices behind a wing with a vortex dissipator. Victor R. Corsiglia, Robert A. Jacobsen, and Norman Chigier (NASA, Ames Research Center, Moffett Field, Calif.). In: Aircraft wake turbulence and its detection; Proceedings of the Symposium, Seattle, Wash., September 1-3, 1970. Symposium sponsored by the Boeing Scientific Research Laboratories and the U.S. Air Force. Edited by J. H. Olsen, Arnold Goldberg, and Milton Rogers. New York, Plenum Press, 1971, p. 229-242. 7 refs.

Results of a wind-tunnel and flight investigation of the effects of a vortex dissipator plate fitted to the wing tip of an aircraft. The wind-tunnel investigation consisted of flow-visualization studies using smoke and a tuft grid as well as measurements with a hot-wire anemometer. Both the smoke and tuft-grid visualization studies indicated that the dissipator caused a significant reduction in the maximum tangential velocities in the trailing vortex. Additional studies with the anemometer showed significant reductions in the magnitude of the tangential velocities, increases in the cross-sectional dimensions of the core of the dissipated vortex, and changes in the turbulence structure. Limited flight tests with a dissipator plate fitted to a Convair 990 wing tip and using a Lear jet aircraft as a probe indicated that the rolling acceleration and the degree of roll control required was less in the modified vortex than in the unmodified vortex. A.B.K.

A71-40497 Vortex wake development and aircraft dynamics. J. E. Hackett and J. G. Theisen (Lockheed-Georgia Co., Marietta, Ga.). In: Aircraft wake turbulence and its detection; Proceedings of the Symposium, Seattle, Wash., September 1-3, 1970.

Symposium sponsored by the Boeing Scientific Research Laboratories and the U.S. Air Force. Edited by J. H. Olsen, Arnold Goldberg, and Milton Rogers. New York, Plenum Press, 1971, p. 243-263. 13 refs.

Discussion of some theoretical and experimental aspects of vortex wake decay. Calculations of the sinuous instability of a trailing pair are extended, using a nonlinear vortex modeling technique, and the effects of initial parameters (particularly, the initially assumed wavelength) are examined. Realistic-looking tresses obtained were demonstrated using computer graphics. More complex modes of vortex decay may be demonstrated by flow visualization in water, using the hydrogen bubble technique. Vortex bursting is shown to be possible before and/or after the 'wavy' mode. These small-scale measurements are shown to be consistent with flight measurements. In another series of experiments, smoke injected into the core of the trailing vortex behind a C-130 wind-tunnel model showed remarkable coherence until the adverse pressure gradient in the wind-tunnel diffuser caused vortex bursting. The effects of auxiliary blowing into or near the vortex core on vortex burst position in the diffuser are discussed qualitatively. The results of a computer simulation concerning the dynamic response and loads induced on an aircraft entering the trailing vortex of a lead aircraft of large size are discussed. In this study, McCormick's or Owen's semiempirical theories were judged as preferable for estimates of vortex decay with distance behind the aircraft. A.B.K.

A71-40498 **Measurements of Boeing 747, Lockheed C5A and other aircraft vortex wake characteristics by tower flyby technique.** Leo J. Garodz (FAA, National Aviation Facilities Experimental Center, Atlantic City, N.J.). In: Aircraft wake turbulence and its detection; Proceedings of the Symposium, Seattle, Wash., September 1-3, 1970. Symposium sponsored by the Boeing Scientific Research Laboratories and the U.S. Air Force. Edited by J. H. Olsen, Arnold Goldberg, and Milton Rogers. New York, Plenum Press, 1971, p. 265-285. 5 refs.

Results of flight tests conducted at two different test sites to gather quantitative data on aircraft vortex wake characteristics using the tower flyby technique. Vortex flow visualization for vortex characteristics and movement was provided by colored smoke grenades mounted on the towers and by injecting CORVUS-type smoke oil into the outboard jet engine exhausts of certain aircraft with wing-mounted engines. Vortex flow velocities were obtained using hot-film/hot-wire sensors. Measured tangential velocities were approximately double those velocities predicted by certain theory. Distinct vortex characteristics peculiar to certain model aircraft and configurations per aircraft model were noted. Given a 'clean' configuration and small flap deflections, the vortex systems of all the aircraft were observed to be of tubular form, relatively small in diameter, very clearly structured, and very persistent. From both recorded data and visual flow observations of the tubular-type vortex system when highest vortex tangential velocities were recorded, the core diameters as outlined by the tower smoke appeared to be small. A.B.K.

A71-40499 **An assessment of dominant mechanisms in vortex-wake decay.** P. B. MacCready, Jr. (Meteorology Research, Inc., Altadena, Calif.). In: Aircraft wake turbulence and its detection; Proceedings of the Symposium, Seattle, Wash., September 1-3, 1970. Symposium sponsored by the Boeing Scientific Research Laboratories and the U.S. Air Force. Edited by J. H. Olsen, Arnold Goldberg, and Milton Rogers. New York, Plenum Press, 1971, p. 289-304. 10 refs.

Discussion of the transport/decay of vortex wakes from an overall perspective evolved from field observations, experiments, and theoretical work beginning 12 years ago. Most of the work involved the effects of wakes on meteorological experiments, rather than the hazards which the organized vortex wakes presented to subsequent aircraft. It is pointed out that this particular series of inputs warrants the conclusion that the atmospheric turbulence and stability often have much to do with determining the descent, spread, interaction, and decay of the vortices. Such factors can sometimes be dominant and, unfortunately, are almost impossible to duplicate in model experiments. A conclusion arising from this background is that the

atmospheric environment must be considered in establishing the mechanisms of vortex interaction and decay, field experiments should include measurements of environmental factors and, in spite of the costs and difficulties of doing quantitative experiments in the atmosphere, the atmospheric laboratory should have a strong emphasis in any total attack on the wake problem. M.M.

A71-40500 **Theoretical and experimental study of the stability of a vortex pair.** S. E. Widnall, D. Bliss, and A. Zelay (MIT, Cambridge, Mass.). In: Aircraft wake turbulence and its detection; Proceedings of the Symposium, Seattle, Wash., September 1-3, 1970.

Symposium sponsored by the Boeing Scientific Research Laboratories and the U.S. Air Force. Edited by J. H. Olsen, Arnold Goldberg, and Milton Rogers. New York, Plenum Press, 1971, p. 305-338. 12 refs. Contract No. AF 44(620)-69-C-0090.

The linear stability of the trailing vortex pair from an aircraft is discussed. The method of matched asymptotic expansions is used to obtain a general solution for the flow field within and near a curved vortex filament with an arbitrary distribution of swirl and axial velocities. The velocity field induced in the neighborhood of the vortex core by distant portions of the vortex lines is calculated for a sinusoidally perturbed vortex filament and for a vortex ring. General expressions for the self-induced motion are given for these two cases. It is shown that the details of the vorticity and axial velocity distributions affect the self-induced motion only through the kinetic energy of the swirl and the axial momentum flux. The presence of axial velocity in the core reduces both the angular velocity of the sinusoidal vortex filament and the speed of the ring. The vortex pair instability is then considered in terms of the more general model for self-induced motion of the sinusoidal vortex. The presence of axial velocity within the core slightly decreases the amplification rate of the instability. Experimental results for the distortion and breakup of a perturbed vortex pair are presented. (Author)

A71-40501 **Structure of a line vortex in an imposed strain.** D. W. Moore (Imperial College of Science and Technology, London, England) and P. G. Saffman (California Institute of Technology, Pasadena, Calif.). In: Aircraft wake turbulence and its detection; Proceedings of the Symposium, Seattle, Wash., September 1-3, 1970.

Symposium sponsored by the Boeing Scientific Research Laboratories and the U.S. Air Force. Edited by J. H. Olsen, Arnold Goldberg, and Milton Rogers. New York, Plenum Press, 1971, p. 339-354. 11 refs. Grant No. AF AFOSR 69-1804.

Investigation of the structure of straight line vortices in a uniform two-dimensional straining field. Two cases are considered in detail, irrotational strain and simple shear. In the first case, it is shown that steady exact solutions of the inviscid equations exist, in which the boundary of the vortex is an ellipse with principal axes at 45 deg to the principal axes of strain. There are two possible axis ratios provided that the ratio between the maximum rate of extension and the vorticity in the core is less than 0.15. The stability of the shapes is considered, and it is shown that the more elongated shape is unstable, while the less elongated one is stable to two-dimensional deformations. There are no steady solutions of elliptical form if the ratio between the maximum rate of extension and the vorticity in the core is greater than 0.15, and it is believed from some numerical work that in this case the strain field will cause the vortex to break up. M.M.

A71-40502 * **A new look at the dynamics of vortices with finite cores.** P. C. Parks (NASA, Langley Research Center, Hampton, Va.; Warwick, University, Coventry, England). In: Aircraft wake turbulence and its detection; Proceedings of the Symposium, Seattle, Wash., September 1-3, 1970.

Symposium sponsored by the Boeing Scientific Research Laboratories and the U.S. Air Force. Edited by J. H. Olsen, Arnold Goldberg, and Milton Rogers. New York, Plenum Press, 1971, p. 355-388. 12 refs.

Crow's (1970) stability theory for wave-like disturbances in a

pair of trailing line vortices is modified to take account of finite core radii and appropriate distributions of vorticity within these cores. The difficulties encountered by Crow in calculating the self-induction effects of each vortex are avoided. For a uniform distribution of vorticity within the cores, the self-induction function is shown to be expressible in terms of modified Bessel functions of the second kind. The essential features of Crow's theory are confirmed with only small numerical changes. The modified theory cannot be used to calculate the growth of perturbations deliberately introduced at the wing of an aircraft, but a further modified, discretized theory amenable to digital computation has been developed to investigate initial growth of these excited waves. Some results from digital computations are presented. M.V.E.

A71-40503

Decay of an isolated vortex. Coleman duP. Donaldson and Roger D. Sullivan (Aeronautical Research Associates of Princeton, Inc., Princeton, N.J.). In: Aircraft wake turbulence and its detection; Proceedings of the Symposium, Seattle, Wash., September 1-3, 1970. Symposium sponsored by the Boeing Scientific Research Laboratories and the U.S. Air Force. Edited by J. H. Olsen, Arnold Goldberg, and Milton Rogers. New York, Plenum Press, 1971, p. 389-411. 7 refs.

The decay of trailing vortex systems behind aircraft is studied by an analysis of the effect of turbulent shear on the decay of a single vortex. Essential in the study is an invariant model of the type used by the authors for boundary-layer and clear-air turbulent calculations in a previous study (1970). Equations of vortex decay based on this model are obtained, and the results of a typical calculation are given. V.Z.

A71-40504

Decay of a vortex pair behind an aircraft. J. N. Nielsen and Richard G. Schwind (Nielsen Engineering and Research, Inc., Mountain View, Calif.). In: Aircraft wake turbulence and its detection; Proceedings of the Symposium, Seattle, Wash., September 1-3, 1970. Symposium sponsored by the Boeing Scientific Research Laboratories and the U.S. Air Force. Edited by J. H. Olsen, Arnold Goldberg, and Milton Rogers. New York, Plenum Press, 1971, p. 413-454. 20 refs. Contract No. AF 44(620)-70-C-0052.

A model of a trailing vortex pair behind an aircraft is presented which is thought to represent a case of extreme vortex persistency and which therefore is relevant from the safety point of view. Three stages are considered in the analysis: a rolling-up stage directly behind the aircraft, a second stage in which the vortices act independently as constant strength equilibrium turbulent vortices, and a third stage where the vortices physically interact and decay in strength. An overall theory is presented encompassing all three stages and aimed at obtaining equilibrium solutions. Calculative examples are presented for all stages. (Author)

A71-40505

Results of trailing vortex studies in a towing tank. John H. Olsen (Boeing Scientific Research Laboratories, Seattle, Wash.). In: Aircraft wake turbulence and its detection; Proceedings of the Symposium, Seattle, Wash., September 1-3, 1970. Symposium sponsored by the Boeing Scientific Research Laboratories and the U.S. Air Force. Edited by J. H. Olsen, Arnold Goldberg, and Milton Rogers. New York, Plenum Press, 1971, p. 455-472. 7 refs.

Results of flow visualization studies performed in a towing tank using an electrochemically activated dye. Although test Reynolds numbers were far below flight Reynolds numbers (10,000 vs 10,000,000), the results were strikingly similar to flight test data. Two types of instability were observed in the tank. An instability associated with the axial flow within the core was observed to destroy the flow in the neighborhood of the core without destroying the motion far from the core. A second instability involving the mutual interaction of the two vortices was observed but was somewhat masked by the first instability. (Author)

A71-40506

Results of the Boeing Company wake turbulence test program. P. M. Condit and P. W. Tracy (Boeing Co., Commercial Airplane Div., Everett, Wash.). In: Aircraft wake turbulence and its detection; Proceedings of the Symposium, Seattle, Wash., September 1-3, 1970. Symposium sponsored by the Boeing Scientific Research Laboratories and the U.S. Air Force. Edited by J. H. Olsen, Arnold Goldberg, and Milton Rogers. New York, Plenum Press, 1971, p. 473-508. 14 refs.

Flight tests conducted to evaluate the hazard for other aircraft by the turbulent wakes generated by such large jet transport airplanes as the 747 and C-5A showed that these wakes did not affect the wake probing aircraft any more than the wake of a 707. The dynamic responses of 737, CV990, and F-86 aircraft were essentially the same when flying in the turbulent wakes of either the 747 or 707. The turbulent wake was found to level off and never descend more than 900 ft below the generating airplane. This indicates that a vertical separation of 1000 ft is sufficient to avoid wake turbulence. In approach and landing tests, it was found that the wake generated in ground effect does not roll up into strong trailing vortices. Consequently, wake turbulence is relatively weak near the runway in the landing flare and takeoff rotation areas. Recommendations which would virtually eliminate hazardous wake turbulence encounters are presented. V.P.

A71-40507

Aircraft response to turbulence including wakes. John C. Houbolt (Aeronautical Research Associates of Princeton, Inc., Princeton, N.J.). In: Aircraft wake turbulence and its detection; Proceedings of the Symposium, Seattle, Wash., September 1-3, 1970. Symposium sponsored by the Boeing Scientific Research Laboratories and the U.S. Air Force. Edited by J. H. Olsen, Arnold Goldberg, and Milton Rogers. New York, Plenum Press, 1971, p. 509-522.

The nature of atmospheric turbulence and the means for establishing aircraft response is reviewed, both from discrete-gust and spectral interpretations. Application is then made to the situation of wake turbulence encounter to show the nature and magnitude of the loads that result. Specific cases are treated, with encounters perpendicular to and parallel to the wake, to bring out the main parameters that are significant. General relations are also developed to show how the wake 'gust' forces on the encountering airplane are related to the lift on the aircraft generating the wake. It is shown that normal loads in excess of 2 g's may be produced by a perpendicular encounter of a wake vortex, and that uncontrollable rolling moments may be caused by encounters along the axis of a vortex. (Author)

A71-40508

Airloads and moments on an aircraft flying over a pair of inclined trailing vortices. W. P. Jones and B. M. Rao (Texas A & M University, College Station, Tex.). In: Aircraft wake turbulence and its detection; Proceedings of the Symposium, Seattle, Wash., September 1-3, 1970. Symposium sponsored by the Boeing Scientific Research Laboratories and the U.S. Air Force. Edited by J. H. Olsen, Arnold Goldberg, and Milton Rogers. New York, Plenum Press, 1971, p. 523-545. 6 refs. Grant No. DA-HC-04-69-C-0015.

When an aircraft flies across the wake of another aircraft, it is subjected to changing airloads and moments induced by the trailing vortices of the first aircraft. The magnitude and characteristics of the time-dependent aerodynamic forces produced are investigated. Both aircraft are assumed to be in horizontal flight but the direction of flight of the second aircraft is assumed to be inclined at a small angle to the trailing vortices of the first aircraft. The airloads in this case will change relatively slowly with time and may be estimated with reasonable accuracy by quasi-steady aerodynamic theory without taking Wagner growth of lift effects into account. To illustrate the methods of analysis employed, calculations were conducted for an aircraft with rectangular wings. G.R.

A71-40509 Aircraft wake turbulence controllability experiment. R. P. Johannes (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). In: *Aircraft wake turbulence and its detection*; Proceedings of the Symposium, Seattle, Wash., September 1-3, 1970.

Symposium sponsored by the Boeing Scientific Research Laboratories and the U.S. Air Force. Edited by J. H. Olsen, Arnold Goldberg, and Milton Rogers. New York, Plenum Press, 1971, p. 547-559.

A flight test experiment is described whose aim was to evaluate the effectiveness of a properly mechanized automatic control system in minimizing aircraft upset due to wake turbulence. Graphs showing the closed-loop frequency response of the aileron actuator and the spoiler actuator are presented, and the outer loop control system is discussed. The improvement in the precision with which formation flying can be accomplished with the aid of the control system applies also to other precision control maneuvers such as landing and paradrop. V.P.

A71-40510 Fog formation and dispersal by trailing vortices. P. Baronti and S. Elzweig (Advanced Technology Laboratories, Inc., Jericho, N.Y.). In: *Aircraft wake turbulence and its detection*; Proceedings of the Symposium, Seattle, Wash., September 1-3, 1970.

Symposium sponsored by the Boeing Scientific Research Laboratories and the U.S. Air Force. Edited by J. H. Olsen, Arnold Goldberg, and Milton Rogers. New York, Plenum Press, 1971, p. 561-573. 14 refs.

A model is presented to explain why fogs can be maintained for extended periods of time. The model considers the fog as a dynamical system whereby droplets depletion through fall is balanced by a continuous process of evaporation and condensation. The controlling parameters of the process are indicated. Possible means of fog dispersal by the velocity field induced by trailing vortices are suggested. (Author)

A71-40530 The loudness of sonic booms heard outdoors as simple functions of overpressure and rise time. D. N. May (Southampton, University, Southampton, England). *Journal of Sound and Vibration*, vol. 18, Sept. 8, 1971, p. 31-43. 21 refs. Research supported by the Ministry of Aviation Supply.

Semi-empirical formulae which represent the loudness of sonic booms heard outdoors as functions of their peak overpressures and rise times only were found to agree well theoretically with the accepted, more complex loudness calculations of Zepler and Harel, and Johnson and Robinson. Moreover, in an experimental assessment using 34 sonic booms and up to 14 subjects, the semi-empirical relations correlated with judged loudness at least as well as did the more complex ones. The use of the semi-empirical formulae was recommended by virtue of their far greater simplicity. In particular, one such formula for loudness in phons is simply the decibel level of the peak overpressure minus twelve, with a further phon subtracted for each millisecond of rise time. (Author)

A71-40590 Fatigue in the context of flight safety. *Flight International*, vol. 100, Sept. 2, 1971, p. 362-365. 10 refs.

The role of pilot fatigue, due to lack of sleep, irregular duty patterns, and sleep disruption, in pilot performance is analyzed. It is shown that sleepiness has much the same effect as alcohol on human skills and that there is a measurable deterioration of performance with lack of sleep. Inability to discriminate (or even detect) small signals was established in test subjects with two to three hours of sleep. Evidence is presented that pilot performance varies diurnally, and that it is affected by desynchronization of diurnal rhythm by time-zone crossing. Rest and duty schedules that would contribute to flight safety are proposed. V.P.

A71-40621 # Brazing filler metal evaluation for an aircraft gas turbine engine application. R. P. Schaefer, J. E. Flynn, and J. R.

Doyle (United Aircraft Materials Engineering and Research Laboratory, East Hartford, Conn.). (*American Welding Society and Welding Research Council, International Brazing Conference, 2nd, San Francisco, Calif., Apr. 27-29, 1971.*) *Welding Journal, Research Supplement*, vol. 50, Sept. 1971, p. 394-s to 400-s.

Investigation of the basic characteristics of some silver-, copper-, and nickel-base brazing filler metals for application as possible cost-effective replacements for the Au-18Ni filler metal in an aircraft gas turbine engine component. A metallographic examination was conducted on brazed AISI 410 tee-joint specimens to evaluate braze flow, joint microstructure, and interaction between the filler metal and the base metal. Oxidation and tensile shear strength testing of each filler metal was conducted up to 1200 F, followed by room-temperature fatigue strength testing of selected brazing filler metals. Actual vane-and-shroud compressor stator assemblies were brazed with selected filler metals under normal production conditions for engine testing to evaluate their reliability under actual service conditions. It is shown that the ductility and strength of the filler metals investigated are related to the joint microstructure. Filler metals of Au-Ni and Cu-Mn-Co which are predominantly solid solution possessed excellent ductility and strength, whereas the properties of the filler metals of Ag-Cu-Pd and Ni-Cr-Si-B with intermetallic and/or eutectic phases were considerably lower at gap width tested. The silver- and copper-base brazing filler metals were shown to be limited by their oxidation resistance, although high-temperature strength was adequate. Brazing filler metals 706 and 9217 satisfied the established goals of this program for service applications to 800 and 1000 F, respectively. (Author)

A71-40679 # Calculation of the diffraction of a shock wave at a profile with subsequent development of stationary supersonic and transonic flows about the profile (Raschet difraktsii udarnoi volny na profile s posleduiushchim ustanovleniem statsionarnogo sverkhzvukovogo i tranzvukovogo obtekanii). A. S. Fonarev. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza*, July-Aug. 1971, p. 34-40. 8 refs. In Russian.

The problem of the impact of a shock wave against a stationary symmetric wing profile is solved with the aid of a difference scheme proposed by Godunov (1959). The diffraction phase of the shock wave is analyzed, and the development of both a supersonic and a transonic flow past a lenticular profile (thickness ratio of 6), for which the freestream Mach number of 0.87 is critical, is determined and compared with the experiment. V.P.

A71-40680 # Contribution to the asymptotic theory of supersonic flow/boundary layer interaction (K asimptoticheskoi teorii vzaimodeistviia sverkhzvukovogo potoka s pogranichnym sloem). V. Ia. Neiland. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza*, July-Aug. 1971, p. 41-47. 10 refs. In Russian.

The propagation of disturbances upstream is studied for supersonic and hypersonic viscous gas flows in which the boundary-layer-induced pressure gradient affects the solution for the boundary layer even in the first approximation. Solutions are obtained for the shockwave/boundary layer interaction region, for a corner in supersonic flow, and for a hypersonic flow characterized by strong boundary layer interaction. V.P.

A71-40681 # Influence of boundary layer disturbances on hypersonic flows with viscous interaction (O vlianii vozmushchenii pogranichnogo sloia na giperzvukovye techeniia s viazkim vzaimodeistviem). I. G. Kozlova and V. V. Mikhailov. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza*, July-Aug. 1971, p. 48-53. In Russian.

The influence of disturbances arising in the boundary layer in three-dimensional flow is assessed for the flow about an infinite triangular plate. It is shown that a pressure drop leads to an increase in the heat-transfer and friction coefficients in flows with strong or moderate viscous interaction, while an increase in pressure results in a decrease of these coefficients. The disturbances caused by a

pressure increase propagate over greater distances than in the case of a pressure drop. The influence of boundary-layer disturbances on the integral characteristics of the flow increase with increasing sweep (the order of these characteristics can increase from 3 to 15% for an increase in sweep angle from 0 to 60 deg). V.P.

A71-40685 # Hydrodynamic interaction of airfoil cascades in potential flow (O gidrodinamicheskom vzaimodeistvii reshetok profilei v potentsial'nom potoke). V. E. Saren. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza*, July-Aug. 1971, p. 75-84. 9 refs. In Russian.

The attached potential flow of an incompressible fluid past two arbitrary airfoil cascades which move with respect to each other is analyzed. It is assumed that vortex trails behind the cascades are absent (quasi-stationary formulation). An approximate method of solving the problem for cascades with an arbitrary pitch is proposed, which is based on expressing the flow rate at the blade profiles in the form of a power series in a small parameter characterizing the distance between the cascades. Asymptotic formulas are derived for calculating the velocity circulation at the blades of a double-row cascade whose first row consists of densely spaced curvilinear profiles and the second of widely spaced straight blades. V.P.

A71-40695 # Interaction of a pitot tube with a subsonic flow of rarefied gas (Vzaimodeistvie nasadka polnogo davleniia s dozvukovym potokom razrezhennogo gaza). Iu. A. Koshmarov and S. B. Svirshchevskii. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza*, July-Aug. 1971, p. 163-167. 10 refs. In Russian.

Experimental study of the influence of gas rarefaction on the value of impact pressure in a thin-walled cylindrical tube with a sharp leading edge at subsonic flow velocities. Experiments were performed at zero angle of attack of Reynolds numbers from 0.59 to 6.99, Mach numbers from 0.2 to 0.7, and Knudsen numbers from 0.043 to 1.54. A formula is derived which makes it possible to interpret the readings of the impact probe for any levels of rarefaction (Knudsen numbers). T.M.

A71-40701 Aerial land rover. D. Lockspeiser. *Flight International*, vol. 100, Sept. 9, 1971, p. 404, 405.

The design of an aircraft which is particularly suited for special needs in the developing countries is considered. It is intended to develop an aircraft able to carry a payload of one ton. Typical of the tasks envisaged for it are passenger and freight transport, crop spraying and dusting, distressed-area relief, air survey, and fire-fighting. A 70% (by size) version of the one-ton carrier was built to prove and demonstrate the intended aircraft configuration. The design of the aircraft is described, and the experience obtained with it in test flights is evaluated. G.R.

A71-40702 Carbon fibres - The first five years. Marcus Langley. *Flight International*, vol. 100, Sept. 9, 1971, p. 406-408. 5 refs.

It is almost five years since carbon fibers were first introduced in the UK with the statement that carbon-fiber-reinforced plastics had been made which had a stiffness-to-weight ratio surpassing that of metals. The new fiber, it was said, was two or three times as strong as steel. Aerospace applications and applications in the medical field are considered for the new materials. Early claims for carbon fibers have been proved to be justified. There are, however, certain difficulties as, for instance, surface erosion problems. G.R.

A71-40704 # Aircraft wake turbulence. Andrew S. Carten, Jr. (USAF, Cambridge Research Laboratories, Bedford, Mass.). *Air University Review*, vol. 22, July-Aug. 1971, p. 12-24. 11 refs.

Both as phenomena and as technical and operational challenges, clear air turbulence (CAT) and aircraft wake turbulence exhibit

striking similarities. Both CAT and aircraft wake turbulence can cause loss of control of aircraft. Aircraft wake turbulence is a man-made atmospheric disturbance found behind all aircraft in flight. In its most severe form it is a threat principally to medium-sized and small aircraft. The most dangerous atmospheric disturbances of this type are those associated with the trailing vortex wakes of the jumbo jets. Aerodynamic aspects related to the aircraft wake turbulence are investigated giving attention to vortex theory. Measures considered for solving the problem include vortex breakup, vortex detection, and the maintenance of conservative separations, in time and in distance, between large and small aircraft. G.R.

A71-40705 # Sonic boom and the supersonic transport. Richard M. Roberds (USAF, Saigon, South Vietnam). *Air University Review*, vol. 22, July-Aug. 1971, p. 25-33. 5 refs.

Relations between flight conditions and the sonic boom created by an aircraft are examined. Atmospheric conditions and aircraft design are other significant factors in sonic boom generation. The most difficult part of the sonic-boom problem associated with the supersonic transport is determining how people will react to the boom. A study of damage to property by sonic boom effects takes into account variation in sonic-boom intensity and factors of damage probability. In conclusion it is pointed out that in spite of unfavorable findings regarding the first-generation SST there is hope that with advancing technology the sonic boom can be reduced below the critical level for a second-generation supersonic transport. G.R.

A71-40709 # Speech intelligibility in the presence of time-varying aircraft noise. Carl E. Williams (U.S. Navy, Naval Aerospace Medical Research Laboratory, Pensacola, Fla.), Karl S. Pearsons (Bolt Beranek and Newman, Inc., Canoga Park, Calif.), and Michael H. L. Hecker (Stanford Research Institute, Menlo Park, Calif.). *Acoustical Society of America, Spring Meeting, 81st, Washington, D.C., Apr. 19-23, 1971, Paper*. 13 p.

Outline of a special test procedure to derive the relation between intelligibility scores and articulation index (AI) for time-varying aircraft noise. This relation is then compared with a relation between intelligibility scores and AI obtained for steady-state simulated aircraft noise. A secondary objective of the study was to compare various physical measures of aircraft noise with respect to their effectiveness in predicting speech intelligibility. It is shown that for a given AI, time-varying noise provides less masking than steady-state noise. F.R.L.

A71-40710 # Sources of noise in axial flow fans. B. D. Mugridge and C. L. Morfey (Southampton, University, Southampton, England). *Acoustical Society of America, Spring Meeting, 81st, Washington, D.C., Apr. 19-23, 1971, Paper*. 60 p. 55 refs. Research supported by the Ministry of Aviation Supply of England.

Review of experiments and theory relating to fan noise sources with emphasis on axial flow machines. The tones generated by supersonic and subsonic rotors at multiples of both blade-passing and disk rotation frequencies are discussed, with major attention to interaction or scattering processes, whereby a subsonic rotor gives rise to a supersonically rotating disturbance pattern. This may occur as a result of unsteady blade forces, or of nonlinear interactions within the flow itself. Three aspects of broadband noise generation by fan blades are described: radiation from turbulent boundary layers; scattering of incident turbulence; and the influence of secondary flows. F.R.L.

A71-40799 # Modeling of a satellite airport system for large metropolitan areas - A systems analysis. Inder K. Sud. *Operations Research Society of America, Annual Meeting, 39th, Dallas, Tex., May 5-7, 1971, Paper*. 196 p. 83 refs. (SU-TR-71-1)

Investigation of the concept of satellite airports for large metropolitan areas. A methodology has been developed to analyze

the different tangible and intangible factors involved in an airport location decision. A computer algorithm computes the optimum system of satellite airports and satellite collection-ports in a metropolis. The satellite collection-port model, in addition to computing locations of collection ports in the region, can be used to compare various transportation modes for transfer of passengers to and from the main airport. The methodology has been tested using data from the San Francisco Bay Area. Depending upon the values chosen for the various parameters, based on 1980 traffic forecasts, up to seven satellite airports and four satellite collection ports, connected to the International Airport by rapid transit link extensions, were found to constitute an optimum system. F.R.L.

A71-40812 **ATLAS - Abbreviated Test Language for Avionic Systems.** T. A. Ellison (United Air Lines, Inc., San Francisco, Calif.). In: Institute of Electrical and Electronics Engineers and Western Electronic Manufacturers Association, Western Electronic Show and Convention, San Francisco, Calif., August 24-27, 1971, Proceedings. North Hollywood, Calif., Western Periodicals Co. (WESCON Technical Papers. Volume 15), 1971, p. 14/3 1-14/3 8. 6 refs.

The ATLAS programming language was developed to provide for exchange of test requirements between airline avionic equipment suppliers and airline engineering and maintenance staffs. The language is easily readable by both men and machines. It expresses the stimulus and measurement requirements of a unit under test (UUT) in terms that are oriented to the parameters, pins, and physical constants as seen from the UUT. It can be employed either directly as a documentation language for manual or automatic test requirements, or with minor adaptations, as a compiler input language. Program organization, statement formats, vocabulary, and syntax diagrams are explained together with the implementation procedures. T.M.

A71-40829 # **Meteorologic influence on the flight of a commercial SST (Influenza meteorologica sul volo di un super-sonico di linea).** A. Baroni. *Rivista di Meteorologia Aeronautica*, vol. 31, July-Sept. 1971, p. 301-305. 9 refs. In Italian.

Discussion of the principal features of meteorologic phenomena such as wind, temperature, turbulence, hydrometeors, ozone, cosmic radiation, and radio activity which affect the flight of an SST, particularly during the transonic acceleration phase. It is pointed out that the operation of the Concorde does not presently seem to involve any risks for the atmosphere, with the exception of the effects of sonic boom, which are controllable, and of some pollution caused by exhaust gases. M.M.

A71-40858 # **Afterburners of modern jet engines. II (Dopalenie współczesnych silników odrzutowych. II).** Ryszard Wiatrek and Stefan Szczeciński. *Technika Lotnicza i Astronautyczna*, vol. 26, Aug. 1971, p. 18, 19, 33. 6 refs. In Polish.

Conclusion of an article describing the properties of jet engines equipped with an afterburner as a means for temporarily increasing the thrust. Problems encountered with the control of exhaust nozzles are outlined, together with some operational advantages of afterburner engines during takeoff and landing. Changes in thrust caused by the replacement of convergent nozzles by convergent-divergent nozzles are illustrated graphically. T.M.

A71-40866 # **Scaling aircraft noise perception.** J. B. Ollerhead (Wyle Laboratories, Inc., Hampton, Va.). *Acoustical Society of America, Spring Meeting, 81st, Washington, D.C., Apr. 19-23, 1971, Paper*. 13 p. 6 refs.

Experimental assessment of the relative merits of each of two methods for calculating the perceived sound level from either (1) weighted sound pressure level scales, or (2) the more complex

loudness/noisiness computation scales, with respect to each method's ability to predict human perception of aircraft flyover noise. In the performed experiment, 32 subjects judged the noisiness of one hundred and twenty recorded flyover sounds. The most significant features of the results are reviewed. M.V.E.

A71-40868 # **Analyses of propeller vortex noise.** David Brown (Wyle Laboratories, Inc., Hampton, Va.). *Acoustical Society of America, Spring Meeting, 81st, Washington, D.C., Apr. 19-23, 1971, Paper*. 9 p. USAF-supported research.

Summary of the characteristic results obtained in a noise measurement program conducted on a series of propeller configurations operated at static conditions. The configurations consisted of 2, 3, 4, and 6 blade arrangements and were operated at low tip speeds and various blade angle settings. The radiated noise data were analyzed for all cases by on-line 1/3-octave band resolution and by subsequent 1% bandwidth analysis. M.V.E.

A71-40871 # **Carbon deposits in jet engines (Nagary v reaktivnykh dvigatel'akh).** K. K. Papok, V. A. Piskunov, and P. G. Iurenia. Moscow, Izdatel'stvo Transport, 1971. 112 p. 121 refs. In Russian.

The formation, composition and properties of the carbon deposits affecting the performance characteristics of jet engines are discussed. General information on such deposits and details on their harmful effects are given, covering their distribution in jet engine components, the factors enhancing their formation (such as the component surface temperature, fuel properties and combustion chamber design), methods of estimating the deposit-forming properties of fuels and methods of deposit reduction and removal. Their harmful effects in gas turbine engines are summarized as (1) a reduced reliability and service life of hot-surface components due to obstructed heat removal and mechanical damage, (2) impaired power and cost performances due to increased hydraulic losses and lower combustion characteristics, and (3) a lower operational efficiency due to mechanical malfunctions. The monograph is intended for engineers, teachers and students concerned with the subject. V.Z.

A71-40875 # **Onboard aerial photography equipment (Bortovye sredstva vozdushnogo fotografirovaniia).** S. V. Knorozov. In: *Geodesy and aerial photography 1969 (Geodeziia i aerofotemka 1969)*. Edited by A. V. Kondrashkov. Moscow, Izdatel'stvo VINITI, 1970, p. 86-118. 146 refs. In Russian.

Aerial photographic equipment covered by the Soviet abstract magazine 'Geodeziia' from 1963 through 1968 is reviewed. Brief descriptions are given for topographic aerial cameras, aerial photograph orientation equipment, onboard navigation instruments, and the AN/USQ-28 mapping survey system. V.Z.

A71-40891 # **Considerations regarding the approach surface and the obstruction clearance surface in approaches with ILS (Consideraciones sobre la superficie de aproximación y la superficie de franqueamiento de obstáculos en las aproximaciones con I.L.S.).** Luis Marquina Sánchez. *Ingeniería Aeronáutica y Astronáutica*, vol. 23, Jan.-Feb. 1971, p. 1-16. In Spanish.

The definitions of various aeronautical terms related to the approach and landing of an aircraft are presented, giving attention to the approach area, the approach surface, the obstruction clearance surface (O.C.S.), and the obstruction clearance limit (O.C.L.). Within the approach area it may be necessary to restrict the creation of new obstructions and to eliminate or to indicate in some way certain objects in order to ensure the safety of the aircraft during the approach. Relations regarding the dimensions of the O.C.S. and the O.C.L. are analyzed, taking into consideration changes in the course of the aircraft due to new obstructions. A number of graphs are provided as a basis for determining the course of the aircraft during

the approach procedure. Some changes in the current specifications are proposed. G.R.

A71-40902 * # Lubrication, friction, and wear in aircraft. Robert L. Johnson and Lawrence P. Ludwig (NASA, Lewis Research Center, Cleveland, Ohio). *NATO, AGARD, Meeting of Structures and Materials, 32nd, London, England, Mar. 28-Apr. 2, 1971, Paper. 72 p. 78 refs.*

Some anticipated and present friction and wear problems in aircraft are discussed and potential approaches for mitigation of these problems are outlined. The status of atomistic and continuum methods for defining surfaces and modes of failure is described. Wear processes are explored in terms of physical and chemical considerations and basic types of wear mechanics are characterized. Solid and liquid lubricant status is generalized. Lubrication by boundary, elastohydrodynamic, and fluid films are conceptually described. Lubrication systems are discussed in regard to future applications. Attention is given to particular problems of specific mechanical components (i.e., bearings, seals, gears, fasteners, etc.). Some approaches are suggested for the study of component wear due to fretting, erosion, scuffing, pitting, and other forms of damage.

(Author)

A71-40950 # Effects of swirling inlet flow on pressure recovery in conical diffusers. A. T. McDonald, R. W. Fox (Purdue University, Lafayette, Ind.), and R. V. Van Dewoestine (Corning Glass Works, Corning, N.Y.). *AIAA Journal*, vol. 9, Oct. 1971, p. 2014-2018. 12 refs.

An experimental investigation was conducted to determine the effect of swirling inlet flow on the performance and outlet flow profile of conical diffusers. Twenty four different diffusers were tested, with total divergence angles ranging from 4.0 to 31.2 deg, and with area ratios from 1.30 to 8.27. The effect of swirling inlet flow on diffuser performance was found to be a strong function of flow regime in the same diffuser with axial inlet flow. Swirling inlet flow did not affect performance of diffusers which were unseparated or only slightly separated with axial inlet flow. For diffusers which were moderately or badly separated for axial inlet flow, swirling inlet flow caused large performance increases based on total inlet kinetic energy. The results indicate that optimum diffuser performance for swirling inlet flow may be higher than that for axial inlet flow. However, the geometry of the optimum diffuser will differ considerably from that for axial inlet flow. New optimums are presented for the three swirl ratios investigated. (Author)

A71-40963 # Calculation of a slender body moving through air at supersonic and subsonic velocities. M. L. Wilkins (California, University, Livermore, Calif.). *AIAA Journal*, vol. 9, Oct. 1971, p. 2073-2075. AEC-sponsored research.

Description of calculations in which a slender body of revolution defined by a set of Lagrange coordinates moves into another set of Lagrange points that have associated with them an equation of state appropriate for air. The Lagrange grid used in the calculation is shown. All the plots were obtained automatically by an IBM 7030 computer as the problem progressed. Because of the cylindrical symmetry, only half of the problem need be calculated. The remaining half is obtained by reflection about the axis of symmetry. Thirty-five grid points were used in the radial direction. In the axial direction, grid points were added in front of and removed from behind the body as time progressed to minimize the computation time without affecting the results in the area of interest. A three-dimensional calculation with the same detail as the two-dimensional calculation presented would require 35 times the number of zones and four quadrants instead of one. By replacing the IBM 7030 with the STAR computer, a 150-fold increase in computation speed is achieved. M.M.

A71-40967 # Flap span effects on boundary-layer separation. Karlheinz O. W. Ball. *AIAA Journal*, vol. 9, Oct. 1971, p. 2080, 2081. 6 refs.

Description of the results of an experimental program to determine the spanwise distribution of the beginning of the separation interaction due to a deflected flap of varying span length. Representative streamwise pressure distributions at various spanwise stations are given for a flap half-span of 1.5 in. The results show that the effects of flap span length cannot be discussed in terms of a flap aspect ratio, or other similar geometric parameters, but must be related to a characteristic dimension of the flow. M.M.

A71-40972 * # Sonic boom minimization including both front and rear shocks. A. R. George and R. Seebass (Cornell University, Ithaca, N.Y.). *AIAA Journal*, vol. 9, Oct. 1971, p. 2091-2093. 11 refs. Grant No. NGR-33-010-054.

The analysis reported by George (1969) is extended to an investigation which covers both front and rear shock strengths. The aircraft weight, effective length, and flight conditions are assumed given and lower bounds for shock strengths are found. The results obtained are presented in a number of graphs. An example is considered involving an SST aircraft 300 ft long, weighing 600,000 lb and flying at $M = 3.0$ in the U.S. Standard Atmosphere. G.R.

A71-40973 # Delta wing shock shape at hypersonic speed. Dhanvada Madhava Rao. *AIAA Journal*, vol. 9, Oct. 1971, p. 2093, 2094.

The feasibility to use the vapor screen technique as a rapid means of determining the shock envelope of complex shapes is investigated. A flat-bottom delta wing model with sharp leading-edges swept back at 75 deg was tested in the Langley 11-in. Blowdown Tunnel. Flowfield photographs were taken at incidence angles of the lower surface of 8, 13, and 18 deg. On the basis of the schlieren results as well as theoretical calculations it is suggested that the vapor screen technique is useful for obtaining quantitative shock information. G.R.

A71-40981 * # Viscous slipstream flow downstream of a centerline Mach reflection. Lloyd H. Back and Robert F. Cuffel (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). *AIAA Journal*, vol. 9, Oct. 1971, p. 2107-2109. 12 refs.

Determination of the mean structure of the viscous flowfield downstream of the triple shock wave intersection on the basis of Pitot and static pressure probe measurements. The measurements were made in air flowing through an axisymmetric supersonic diffuser. The over-all features of the centerline Mach reflection are indicated in a graph by static pressures and Mach numbers along the centerline and along the edge of the slipstream. G.R.

A71-40999 The turbulent near-wake of infinite axisymmetric bodies at Mach four. W. R. Sieling (Bell Telephone Laboratories, Inc., Murray Hill, N.J.), C. E. G. Przirembel, and R. H. Page (Rutgers University, New Brunswick, N.J.). In: *Midwestern Mechanics Conference, 12th, University of Notre Dame, Notre Dame, Ind., August 16-18, 1971, Proceedings.* Conference supported by the National Science Foundation and the U.S. Air Force. Edited by L. H. N. Lee and A. A. Szewczyk. Notre Dame, Ind., University of Notre Dame Press (Developments in Mechanics. Volume 6), 1971, p. 333-344. 22 refs. Contract No. AF 44(620)-68-C-0018.

An experimental investigation of the axisymmetric turbulent near-wakes generated by two base configurations (blunt and hemispherical) in a free stream with a nominal Mach number of four and high Reynolds number is reported. A special annular wind tunnel, which completely eliminated model support and forebody disturbances, was used to obtain detailed pressure measurements in all regions of the near-wakes, as well as on the surface of the models. Various flow visualization techniques were exploited to verify the location of the separation and rear stagnation points, and to determine qualitatively the overall flow patterns. Comparison of the

data for the two base geometries indicated a noticeable similarity between the two reattachment processes. (Author)

A71-41246 Debating AR. Karl H. Bergey. *Shell Aviation News*, no. 398, 1971, p. 14-18.

Development of the proposition that aspect ratio (AR) as such does not have a direct effect on either drag or performance, although it plays a major part in determining the induced drag coefficient. In practice, it is drag and not drag coefficient that must be overcome by thrust. It is considered that it is span loading, expressed as weight per unit length of span, and not AR, that determines how efficiently a wing performs its lifting function. Delta wing performance and individual drag components are discussed. F.R.L.

A71-41247 Unassisted aircraft parking. C. C. Harvey (United Air Lines, Inc., Chicago, Ill.). *Shell Aviation News*, no. 398, 1971, p. 19-21.

Description of a system (Accu-Park) to permit flight captains to park safely and accurately at the gate without relying on a guideman to relay signals to them. Basically, the system establishes a point in space with a visual track leading to that point. This point may be used as a stopping point, or parking position for the aircraft, or as a point of reference for a turn or other ground maneuver. The equipment consists of two boxes each of which has two vertical sections of narrow beam, high intensity neon. The rear neon section is red and projects 12 in. above the box; the front neon section is green and projects 8 in. These two neon sections form a 'gun-site' visible from virtually any distance, even on the brightest day. F.R.L.

A71-41300 # Certain results of the use of an aircraft heat viewer for studying the radiation of underlying surfaces (Nekotorye rezul'taty primeneniia samoletnogo teplovizora dlia issledovaniia izlucheniia podstilaushchikh poverkhnosti). B. P. Sokol'skii and A. P. Chernenko. In: Study of radiation processes in the atmosphere (Issledovanie radiatsionnykh protsessov v atmosfere). Edited by K. Ia. Kondrat'ev. Leningrad, Gidrometeoizdat (Glavnaia Geofizicheskaya Observatoriia imeni A. I. Voeikova, Trudy, No. 252), 1970, p. 17-25. In Russian.

Consideration of the possibility of using an aircraft heat viewer to study the radiation properties of various underlying surfaces. A brief description is given of the functional diagram of the device. The advisability of combining a qualitative survey-type thermal aerial photo with simultaneous radiometric measurements in such aircraft studies is indicated. A.B.K.

A71-41380 # Study of a miniature wind tunnel for testing anemometers (Issledovanie malogabaritnoi aerodinamicheskoi truby dlia poverkni anemometrov). N. P. Fateev, L. L. Ponkratovich, and Ts. Sh. Ogorodnikova. In: Meteorological observation procedures and instrument testing (Metodika meteorologicheskikh nabludenii i poverka priborov). Edited by D. P. Bespalov. Leningrad, Gidrometeoizdat (Glavnaia Geofizicheskaya Observatoriia imeni A. I. Voeikova, Trudy, No. 260), 1971, p. 152-162. 7 refs. In Russian.

Study of the characteristics of the velocity field in the working section of a miniature wind tunnel developed for testing anemometers. The magnitude and location of the velocity vector at various points in the field were determined by a high-accuracy null method involving the use of a spherical probe. The working field was investigated with the aid of a pneumometric tube and a calibrated opening in a nozzle. On the basis of these studies, the non-uniformities of the velocity field in various cross sections of the field are determined, as well as the flow stability. A.B.K.

A71-41399 # Application of jet flaps to an autogyro rotor (Sull'applicazione dei profili a supercircolazione /jet flap/ al rotore dell'autogiro). Vittorio Fiorini (CNR, Centro Ricerche Aerospaziali,

Rome, Italy). *Ingegneria*, July-Aug. 1971, p. 477-483. 10 refs. In Italian.

Discussion of the possibility of applying jet flaps to an autogyro rotor by exploiting the pressure jump between upstream and downstream of the nozzle occurring in the case of a rotor's rotating blade as a consequence of air centrifugation in the blade's internal duct. A numerical application for a twin-bladed rotor was made in the AVIAN Gyroplane. From a dimensional viewpoint, the advantage deriving to a rotor with a jet flap is the possibility of using diameters approximately 10% smaller than those of conventional rotors, the lift remaining unchanged. M.M.

A71-41491 Aircraft flashing lights - A summary of Canadian Forces investigations. F. C. Brewer. In: The perception and application of flashing lights; Proceedings of the International Symposium, Imperial College of Science and Technology, London, England, April 19-22, 1971. London, Adam Hilger, Ltd., 1971, p. 281-287. 7 refs.

Recent work on aircraft warning signals, navigation and anti-collision displays, and the autokinetic phenomenon carried out by the Canadian Forces is reviewed. Covered are two laboratory experiments on warning signals, three operational studies on anti-collision and navigation lights, and one laboratory experiment on autokinetic latency and displacement. The results are summarized as follows: pilots wearing spectacles in flight are not less sensitive to peripheral visual stimulation than others. The tactile warning display studied is not effective in easing the workload of the visual system. Strobe lights of white rotating beacons should not be used on aircraft. Any rotating beacons operating in clouds can cause disorientation. Conventional navigation and anticollision lighting systems fail to indicate aircraft flight path and altitude. Aircrew should be briefed on, but not trained in, autokinetic motion. V.Z.

A71-41493 Strobe lighting - A strengthening factor for the 'see and be seen' backbone of collision avoidance. James G. Golden (Air Line Pilots' Association). In: The perception and application of flashing lights; Proceedings of the International Symposium, Imperial College of Science and Technology, London, England, April 19-22, 1971. London, Adam Hilger, Ltd., 1971, p. 303-310.

The potential of strobe lighting in aviation is discussed as an effective approach to the reduction of the ever increasing midair collision hazards. The Collision Avoidance System (CAS) developed by the Airline Transport Association and the more recent Pilot Warning Indicator (PWI) are assessed, noting the latter as the one which is more promising for the application of strobe lighting to assist pilots in sighting approaching aircraft. Arguments are given in favor of a speedy introduction of strobe lighting into aviation. V.Z.

A71-41494 Hardware design for aircraft flashing light applications. Paul H. Greenlee (Grimes Manufacturing Co., Urbana, Ohio). In: The perception and application of flashing lights; Proceedings of the International Symposium, Imperial College of Science and Technology, London, England, April 19-22, 1971. London, Adam Hilger, Ltd., 1971, p. 311-322.

The properties and performance of various aircraft flash light system designs used on aircraft since their introduction in 1957 are discussed. The evolution of the first prototype white anticollision lights used on DC-6 into improved designs is reviewed. Some details are given on flash light systems used on Bonanza, DC-8 and 10, and Lockheed L-1011 aircraft in design tests. Tandem oscillating lights, fixed lamp rotating reflectors and lenses, the xenon flashtube, the quartz-iodine lamp, and flash frequencies are covered. V.Z.

A71-41499 Flashing lights on aircraft. L. D. Heynemann (Ministère des Armées, Service Technique Aéronautique, Paris, France). In: The perception and application of flashing lights;

Proceedings of the International Symposium, Imperial College of Science and Technology, London, England, April 19-22, 1971. London, Adam Hilger, Ltd., 1971, p. 397-399.

Comments on current practice complying with present national and international regulations concerning flashing anticollision lights, which seem to provide the most conspicuous signal. Attention is given to flash frequency, color considerations, source of light, perception of quick flashing lights, and lights for supersonic aircraft.

F.R.L.

A71-41500 * # Wake and boundary layer effects in helicopter rotor aerodynamics. David R. Clark (United Aircraft Corp., Sikorsky Div., Stratford, Conn.) and Anton J. Landgrebe (United Aircraft Research Laboratories, East Hartford, Conn.). *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 4th, Palo Alto, Calif., June 21-23, 1971, Paper 71-581*. 16 p. 18 refs. Members, \$1.50; nonmembers, \$2.00. Grants No. DA-AJ-02-0070-C-0009; No. DA-AJ-02-0069-C-0056; No. DA-AJ-02-0069-C-0039; Contract No. NAS 1-8350.

Theoretical methods recently developed within United Aircraft are discussed in light of the new understanding they give to the aerodynamics of the helicopter rotor. Results of wake geometry prediction methods, supported by experimental data, emphasize the importance of wake effects on rotor performance and behavior. These effects are shown to be especially important in hover and low speed forward flight as well as for high speed flight at low disk angles. The influence of viscosity has been studied with particular emphasis on the development of the blade boundary layer. Using two independent boundary layer calculation methods, centrifugal pumping has been shown to play only a minor role with Coriolis forces and streamline curvature effects predominating. Away from separation and in the absence of large crossflows or excessive streamline curvature the boundary layer flow appears to be essentially two dimensional when taken in the direction of the external stream.

(Author)

A71-41509 # A satellite navigation system for general aviation and marine use. T. M. B. Wright. (*European Space Symposium, 11th, Berlin, West Germany, May 24-26, 1971*.) *British Interplanetary Society, Journal*, vol. 24, Oct. 1971, p. 591-602.

The aims of this paper are to establish the conditions under which a satellite system for marine and aviation use is economically viable, the features it must incorporate to make it operationally attractive, and the basis for the technical solution. The emphasis is on the aviation aspect, since this application is generally regarded as the nearer in time. Nothing is said however which is not also true of the marine environment, although there are inherent differences of certain economic and technical parameters.

(Author)

A71-41517 Flight testing starts on the VAK 191B. Rolf Riccius (Vereinigte Flugtechnische Werke-Fokker GmbH, Bremen, West Germany). *Interavia*, vol. 26, Sept. 1971, p. 1037-1039.

The history and current status of the development program of the VAK 191B (the German version of the Panavia 200 Multi-role combat VTOL aircraft/MRCA/) are discussed. Detailed ground trials with the prototype VI were followed by a comprehensive bench testing program with first operation of the T112 auxiliary power unit and subsequently with the RB 191-12 vectored-thrust engine and lift jets. Other tests included pre-optimization of the auto pilot, static destructive testing of the airframe, taxiing trials, testing of power plant behavior under various flow conditions, and hover flight testing with the aid of a special rig. After the hover flight trials, the aircraft will be tested in transition from hover to aerodynamic flight and vice versa. Planning is under way to use the VAK 191B as the MRCA test craft.

V.P.

A71-41518 Honeywell modular automatic test equipment. Robert B. Gustafson (Honeywell, Inc., Minneapolis, Minn.).

Interavia, vol. 26, Sept. 1971, p. 1069-1071.

A test equipment system designed to solve the maintenance problem for the DC-10 and future aircraft is described. The system provides computer control over the station and the testing function. A modular concept and method of construction allows a basic station configuration to be used for a variety of purposes with a maximum of commonality between various stations. The block diagram of the system is given and discussed.

V.P.

A71-41519 UK military and civil air traffic control in harmony. D. L. Stevenson. *Interavia*, vol. 26, Sept. 1971, p. 1072-1075.

A project aimed at ensuring smooth flow of civil air traffic, to coordinate it with military aircraft movements, and to improve ATC by introduction of new equipment and techniques is discussed. Particular attention is given to Mediator, the code name given to the plan for the modernization of the UK air traffic control service over the next decade. Under this plan, civil and military controllers work as a team, under the direct supervision of a 'crewchief.' Among the principal improvements is the use of a secondary surveillance radar system and the introduction of bright radar displays.

V.P.

A71-41569 Hyperventilation in flying personnel (Report of 13 cases) (L'hyperventilation dans le personnel navigant /A propos de 13 observations/). R. Pannier, G. Leguay, and A. Didier (Ministère des Armées, Hôpital d'Instruction des Armées Dominique Larrey, Versailles, France). *Revue de Médecine Aéronautique et Spatiale*, vol. 10, 2nd Quarter, 1971, p. 63-66. In French.

Discussion of the effects of hyperventilation, defined as an inappropriate ventilation above that necessary to meet the requirements of the organism. The syndrome expresses itself by numerous symptoms, dominated by paresthesia and eventually by contractions of the extremities. Among aircrew, the cause is frequently psycho-emotional. An essential element of treatment is to explain the mechanism by which hyperventilation can be controlled.

F.R.L.

A71-41571 The interest of chemical oxygen in air evacuations to hospital (Intérêt de l'oxygène chimique dans les évacuations sanitaires aériennes). H. Ducros (Centre d'Essais en Vol, Brétigny-sur-Orge, Essonne, France). *Revue de Médecine Aéronautique et Spatiale*, vol. 10, 2nd Quarter, 1971, p. 71-74. 10 refs. In French.

Discussion of the use of chemical compounds to supply oxygen to air-transported patients, thus replacing heavy and cumbersome oxygen bottles. Highly oxygenated salts such as permanganates and especially chlorates are suggested. A chlorate of soda 'candle' enclosed in a generating assembly is described, and is considered to be a source of chemical oxygen suitable for many applications.

A71-41572 The transport of sick and injured aboard regular airliners (Le transport des malades et blessés à bord des avions de ligne réguliers). J. Lavernhe, J. Pasquet, M. Perin, and E. Lafontaine. *Revue de Médecine Aéronautique et Spatiale*, vol. 10, 2nd Quarter, 1971, p. 75-77. 6 refs. In French.

Consideration of the various factors involved in air transport of sick or injured persons, with an attempt to determine what pathological or psychological conditions forbid such transport. In general, a patient can be carried provided there is no inconvenience to the crew or other passengers. Among medical contraindications are serious heart conditions, certain respiratory and digestive ailments, glaucoma, otitis, and severe mental disturbance. As a rule, air transport is considered far superior to other means of carriage, and medical incidents in flight have been rare.

F.R.L.

A71-41576 The world gliding championships of Marfa, Texas - Survey of the medicophysiological supervision of the French team (Les championnats du monde de vol-à-voile de Marfa/Texas/ -

Bilan de la surveillance médico-physiologique de l'équipe de France. J.-P. Crance and M. Boulange (Nancy, Université, Nancy, France). *Revue de Médecine Aéronautique et Spatiale*, vol. 10, 2nd Quarter, 1971, p. 94-96. In French.

Discussion of the medical problems of the French gliding team, among which were adaptation to the subtropical semidesert climate, nutrition, protection against hypoxia in the course of certain flights, protection against local fauna, and general supervision of the pilots' physical and psychomotor conditions. In general, weight losses were noted, and there was a greatly increased fluid intake. F.R.L.

A71-41617 International bibliography on the problem of air piracy (Bibliographie internationale sur le problème de la piraterie aérienne). Michel Smirnoff. *Revue Générale de l'Air et de l'Espace*, vol. 34, no. 2, 1971, p. 191-199. In French.

Tabulation of 175 articles dealing with air piracy or hijacking. The individual papers consider the subject with reference to national and international law, problems of extradition of air pirates and their punishment, methods of prevention, and methods of ensuring the safety of passengers and crews. F.R.L.

A71-41630 Capability of a projected 1975 airborne solid-state phased-array radar. J. D. Adams (Georgia Institute of Technology, Atlanta, Ga.). *Microwave Journal*, vol. 14, Sept. 1971, p. 23-26, 28, 30 (3 ff.). 26 refs. Contract No. AF 33(615)-68-C-1600.

In this paper the performance levels of solid-state devices which have potential application as transmitter sources for an airborne phased-array radar are projected to the 1975 era. For airborne applications, X-band operation is of most interest. Within these guidelines, it is concluded that the best 1975 performance can probably be obtained with some type of TRAPATT device. Radar performance is evaluated for an assumed phased-array radar of the elemental module configuration. It is shown that good performance can be achieved in all modes required of a multifunction radar for logistics aircraft. Finally, the relative cost and efficiency of solid-state phased-array radars vs conventional radars is briefly discussed. (Author)

A71-41634 Progress report - NAS Stage A. Warren F. Ottinger (National Airspace System Program Office, Washington, D.C.). *Journal of Air Traffic Control*, vol. 14, Sept. 1971, p. 8-12.

Discussion of the en route Stage A system of air traffic control, which displays digitized radar data positions along with the automatic track positions. The terminal systems display broadband data initially with the automatic track position. The system is being introduced in a flight data processing phase and a radar data processing program. F.R.L.

A71-41666 A two-axis rate gyroscope using externally pressurized gas bearings. R. G. White (Royal Aircraft Establishment, Farnborough, Hants., England). In: Gas Bearing Symposium, 5th, University of Southampton, Southampton, England, March 23-26, 1971, Proceedings. Volume 1. Southampton, England, University of Southampton, 1971, p. 9-1 to 9-26; Discussion, vol. 2, p. 20; Author's Reply, p. 20, 21.

Description of a two-axis pneumatic rate gyroscope which can be used as a sensor for fluidic autostabilizers in airborne vehicles. The device uses externally pressurized gas bearings for both support and control functions. Tests on an experimental unit have shown that it can satisfactorily measure rates of rotation and that the signal levels produced are satisfactory for driving a fluidic system. T.M.

A71-41691 # Lag of aircraft response during flight over an obstacle (Zpoždění reakce letounu při přeletu překážky). Vlastimil Pokorný. *Zpravodaj VZLÚ*, no. 3, 1971, p. 7-13. In Czech.

Factors responsible for the lag of an aircraft's response to the pilot's or autopilot's command during an altitude-control maneuver are identified, and numerical calculations of lag magnitudes are performed for specific situations. In addition to exact calculations, a simple approximate method of solution is proposed and verified. The results can be used to describe control maneuvers during high-speed low-altitude flight over terrain obstacles. T.M.

A71-41692 # Problem of adjusting random-loading parameters in fatigue tests of structural elements (K problematice nastavování parametrů náhodného zatížení při únavových zkouškách konstrukčních částí). Jiří Běhal. *Zpravodaj VZLÚ*, no. 3, 1971, p. 15-19. 7 refs. In Czech.

An extensive research program on fatigue damage mechanisms in welded aircraft structures included simulation of real loading processes with the aid of a parametrically excited loading system that provides random stress variations for nonstationary random loading with a complex pulse shape. The block diagram of the loading system is analyzed, and it is shown that under certain assumptions the calculated control probability of the random-pulse generator can be corrected to provide a required loading program. T.M.

A71-41693 # Reinforcement of thin-walled open sections with constrained buckling (Vzpěr tenkostěnných otevřených profilů s vázaným vybočením). Jiří Hlaváček. *Zpravodaj VZLÚ*, no. 3, 1971, p. 21-26. In Czech.

Description of a method for calculating the buckling stress for thin-walled open sections with a design-constrained direction of buckling. A simple formula is derived for taking into account the influence of the elastic foundation. A numerical example illustrates the difference between the buckling stresses for a section which is free to buckle in any direction and for a section with a design-constrained plane of buckling. T.M.

A71-41796 A critical look at an airport noise control ordinance. Meier Schneider (San Fernando Valley State College, Northridge, Calif.). *American Industrial Hygiene Association Journal*, vol. 32, July 1971, p. 480-487. 29 refs.

The state of California has very recently proposed rules and regulations aimed at providing noise standards governing the operation of aircraft and aircraft engines for airports operating under a valid permit issued by the Department of Aeronautics. The proposed rules and regulations are critically examined with respect to their enforceability and feasibility. It is concluded that the proposed noise regulations appear to be unduly complex and will place a heavy financial burden upon airport operators when implementation is required by law. However, enforcement appears feasible. In the long run such regulations would accomplish a much needed reduction of noise levels in the vicinity of airports. G.R.

A71-41823 Survey of the medical causes of rejection of applicants for the BEA/BOAC sponsored ab-initio pilot training scheme. R. M. Barnes (Air Corporations Joint Medical Service, London Airport, Hounslow, Middx., England). *Aerospace Medicine*, vol. 42, Sept. 1971, p. 941-946. 5 refs. Research supported by the Royal Air Force and the Ministry of Defence (Navy).

Since 1960 BEA and BOAC have sponsored young men between 18 and 24 years of age for ab-initio pilot training. Applicants may be excluded on medical grounds at three stages of the selection procedure. An analysis of the causes of medical rejection at each stage was made. The results have been compared with those obtained by the RAF Aircrew Selection Center and the Royal Naval Officer Candidate Selection Board, the latter representing a group of applicants of similar age not connected with flying. In the Corporations and RAF, ophthalmic, ear, nose and throat and general medical conditions were the major causes of failure, in that order, accounting for some 89% of those rejected. In the Royal Navy, ophthalmic

conditions were by far the most important reason for rejection, followed by general medical causes. Ear, nose and throat diseases accounted for only 2%. A follow-up of candidates selected for training by BEA and BOAC shows that out of 625 candidates who could have completed training, 11 have had to give up flying permanently on medical grounds. On these figures it is concluded that there are no reasons to alter the selection procedure at the present time. (Author)

A71-41824 Study of simulated airline pilot incapacitation. Phase II - Subtle or partial loss of function. C. R. Harper, G. J. Kidera, and J. F. Cullen (United Air Lines, Inc., Denver, Colo.). *Aerospace Medicine*, vol. 42, Sept. 1971, p. 946-948.

The risk factor in airline flight operations generated by partial loss of cerebral function of one crew member is discussed with regard to etiology, incidence and detection. Airline flight crews have received little instruction concerning subtle cerebral incapacitation, and no observations existed regarding the reactions of the crew members who remained unimpaired. An original study involving 36 line qualified B-727 flight crews was performed in an aircraft simulator. The pilot-in-command became nonfunctioning, but not unconscious, during approach for landing. Reaction times of the unimpaired crew members and their subsequent conduct are discussed. Educational recommendations are presented. (Author)

A71-41829 # Performance and fatigue in experimental double-crew transport missions. D. A. Harris, G. Verne Pegram, and Bryce O. Hartman (USAF, School of Aerospace Medicine, Brooks AFB, Tex.). *Aerospace Medicine*, vol. 42, Sept. 1971, p. 980-986. 10 refs.

Six experimental transport missions using a double crew were flown in a C-141 on routes generating various combinations of long and short legs. Crews followed a 4/4 of 16/16 work/rest schedule within operational constraints. On-board crew-rest facilities were provided so that the plane could fly through the airlift system without crew changes or crew delays. The missions required approximately 55-60 hours to complete. The flying time averaged around 43 hours. Crew performance was evaluated by ratings made by an on-board flight examiner. There were no significant differences in flight examiner ratings. Subjective fatigue was measured by a rating scale. There were no significant differences related to work/rest cycles. There were significant differences related to mission profile and crew position. Sleep EEGs were recorded on the two navigators and were supplemented by self-reports from all crewmembers. There was a marked reduction in total sleep as well as stage 1-REM and deep sleep. Findings are discussed in relation to the demands of flying transport missions. (Author)

A71-41834 Investigation of fatal aircraft accidents - 'Physiological incidents.' Laurence R. Simson, Jr. (USAF, Air Training Command, Randolph AFB, Tex.). *Aerospace Medicine*, vol. 42, Sept. 1971, p. 1002-1006. 5 refs.

Incapacitating or distracting physiological phenomena occur with considerable frequency during aerial flight. Only rarely, however, have such 'physiological incidents' been firmly established as cause factors in fatal aircraft accidents. By tradition medical investigation of accidents has largely been restricted to cataloguing mechanical trauma and searching for preexisting organic disease. By definition 'physiological incidents' are transient functional disturbances and not expected, by the inexperienced investigator, to be amenable to demonstration after the fact. However, it is often possible to reconstruct, with high probability, physiological factors which initiated a sequence of events terminating in a fatal accident. Two cases are presented as illustrations. Attention is drawn to the fact that 'physiological incidents' and psychological factors undoubtedly underlie many presently obscure aircraft crashes. (Author)

A71-41840 Air freight - A growth industry with problems. Gunnar K. Sletmo (Columbia University, New York, N.Y.). *Columbia Journal of World Business*, vol. 6, Sept.-Oct. 1971, p. 39-46.

General discussion of the air freight industry from the economic point of view. Forecasts suggest that air freight may show almost a tenfold increase in volume between 1968 and 1985. For this to happen, it is considered that air freight will have to break its relationship to air passenger travel. About half of the world's air freight already moves in all-cargo jets. The superior flexibility and high speed of air freight can more than make up for the higher cost in many situations. F.R.L.

A71-41842 # Study of the flow pattern in front of a blade cascade in a two-dimensional supersonic flow (Issledovanie techenia pered reshetkoi v ploskom sverkhzvukovom potoke). A. M. Domashenko. *Lopatochnye Mashiny i Struinye Apparaty*, no. 5, 1971, p. 6-27. In Russian.

Quantitative analysis of the flow pattern in front of a blade cascade in a supersonic gas flow, performed in accordance with the theory of flow in front of a blade cascade developed by Grodzovskii et al. (1967). On the basis of this analysis an estimate is made of the velocity in front of an infinite cascade for the case where the shock wave configuration and the velocity at a single point in front of the cascade are known. An estimate is also made of the loss in an infinite system of shock waves. A method of experimentally studying the flow pattern in blade cascades with the aid of two-dimensional wind tunnels in the case where only a small number of blades are present in the cascade is proposed and shown to be valid. A.B.K.

A71-41843 # Conditions of existence of a normal shock in elements of an axial-flow supersonic compressor (Usloviia sushchestvovaniia priamogo skachka uplotneniia v elementakh oseвого sverkhzvukovogo kompressora). Iu. N. Vasil'ev and G. A. Freiman. *Lopatochnye Mashiny i Struinye Apparaty*, no. 5, 1971, p. 28-44. In Russian.

Determination of the conditions of existence of a normal shock in the blade spacings of the rotor and guide vanes of an axial-flow supersonic compressor stage with a finite number of blades. The equations which make it possible to calculate the flows satisfying these conditions are derived. In the case of the flow in the guide vanes the basic equations are integrated in finite form. It is shown that the realization of a normal shock in this case requires the creation of a large nonuniformity of the total pressure along the radius. In the case of the flow in the rotor the equations are integrated numerically. It is established that the required nonuniformity of the total pressure along the radius is smaller in this case than in the case of the guide vanes. A.B.K.

A71-41972 # Practical calculation of maximum rate of climb. M. Saarlus (U.S. Naval Academy, Annapolis, Md.). *International Astronautical Federation, International Astronautical Congress, 22nd, Brussels, Belgium, Sept. 20-25, 1971, Paper. 25 p.* 5 refs.

Two simple analytical expressions of jet engine thrust are proposed for flight vehicle climb optimization. Procedures for determining the velocity of minimum time of climb are given for stratospheric and tropospheric flights. Correction factors are calculated for stratospheric and tropospheric flights. It is shown that the correction factors are higher for small engines than for large engines and increase with velocity much faster for the former than for the latter. V.Z.

A71-41984 # A critical review of development of experimental methods in high speed aerodynamics. J. Lukasiewicz (Carleton University, Ottawa, Canada). *International Astronautical Federation, International Astronautical Congress, 22nd, Brussels, Belgium, Sept. 20-25, 1971, Paper. 26 p.* 77 refs.

The development of high speed aerodynamic test facilities during the past 25 years is reviewed. Deficiencies in aerodynamic testing are pointed out, possibilities of future improvements are suggested, and technical trends and future prospects are discussed.

M.V.E.

A71-41993 # The evolution of aerospace guidance technology at the Massachusetts Institute of Technology 1935-1951. C. S. Draper (MIT, Cambridge, Mass.). *International Astronautical Federation, International Astronautical Congress, 22nd, Brussels, Belgium, Sept. 20-25, 1971, Paper. 49 p. 41 refs.*

Historical review of work accomplished in the field of guidance technology, mainly with reference to inertial systems. The theoretical background is based on Newton's law of inertia. Much of the progress stems from work previously carried out on fire control developments which were based on the use of gyro units. Various types of inertial guidance systems are described.

F.R.L.

A71-41999 * # Gaseous hydrogen embrittlement of aerospace materials. D. P. Williams and H. G. Nelson (NASA, Ames Research Center, Moffett Field, Calif.). *International Astronautical Federation, International Astronautical Congress, 22nd, Brussels, Belgium, Sept. 20-25, 1971, Paper. 14 p.*

Discussion of the various phenomena and effects involved in metal embrittlement by hydrogen, and review of some of the countermeasures used. It is shown that any method which prevents the hydrogen molecule from dissociating to its constituent atoms on the clean metal surface will hinder the hydrogen metal interaction and forestall cracking.

M.V.E.

A71-42011 # International cooperation - The Concorde experiment. R. Chevalier. *International Astronautical Federation, International Astronautical Congress, 22nd, Brussels, Belgium, Sept. 20-25, 1971, Paper. 17 p.*

The type of organization suitable for programs involving the cooperation of a number of countries in aerospace projects is discussed. A typical example for such an international operation provides the development of the Concorde. The initial projects for an SST were presented during the time from 1960 to 1961. The maiden flight of the prototype took place in 1969 with a delay of about 2 years on the 1962 estimations. The basic organization for the Concorde project is discussed together with aspects of the work share given to the individual partners.

G.R.

A71-42035 # Investigation of the flow at inlet to a centrifugal compressor impeller. A. Y. Barodekar and J. H. Blackburn (Liverpool, University, Liverpool, England). *International Astronautical Federation, International Astronautical Congress, 22nd, Brussels, Belgium, Sept. 20-25, 1971, Paper. 36 p. 5 refs.*

The first stage of a Rolls Royce Dart centrifugal compressor provided a flow with suitable Mach number and compressibility for testing a quasi-three dimensional flow model. As successful operation of the flow model depended on supplying the program with the correct inlet conditions an accurate experimental survey was required to determine the values of pressure temperature and velocity just upstream of the rotating guide vanes. It was the aim of this project to establish whether the flow was axisymmetric and to obtain the required parameters by traversing with suitable probes. Because of the number of inaccessible positions around the circumference the proof of axisymmetry was dependent on being able to relate the results from a small number of traversing planes with the rest of the intake.

(Author)

A71-42068 Wrongful death in aviation and the admiralty - Problems of federalism, tempests and teapots. James R. Craig (Southern Methodist University, Dallas, Tex.) and Larry G.

Alexander. *Journal of Air Law and Commerce*, vol. 37, no. 1, 1971, p. 3-48. 560 refs.

The lack of a uniform standard of recovery under state wrongful death statutes has spawned numerous problems unique to the aviation and shipping industries. Although both industries deal almost exclusively in interstate and foreign commerce, Congress has refused to enact federal wrongful death legislation that would control situations interfering with a state's interest in the application of its law. The resulting uncertainty provokes confusion. In cases invoking the admiralty jurisdiction, for example, state wrongful death law, used to grant relief otherwise not available, has often provided more restrictive remedies than would be the case under the maritime law, thus retarding effective application of federal standards. Drawing a parallel of air and sea commerce, an analysis based on the broad policies of maritime recovery for wrongful death is proposed, and it is suggested that the same arguments are available to the federal courts for the creation of a federal common law of aviation.

M.M.

A71-42069 A plea for the preservation of the 'worm's eye view' in multidistrict aviation litigation. John H. McElhaney (Southern Methodist University, Dallas, Tex.). *Journal of Air Law and Commerce*, vol. 37, no. 1, 1971, p. 49-64. 126 refs.

The seven federal district and court of appeals judges composing the Judicial Panel on Multidistrict Litigation have the power to transfer cases involving the same questions of fact to a single district for consolidated pretrial hearings. The usefulness of this procedure in aircraft crash cases is obvious, but limited. After developing the point that the existing procedures are not patterned for aviation litigation, it is argued that the interests of the litigants, especially the claimants, are not adequately protected, even harmed. Eight problems that together suggest the creation of separate procedures for aviation cases are separated.

M.M.

A71-42070 Control of an air carrier by 'any other person' Flying blind under the Federal Aviation Act. Raymond J. Rasenberger. *Journal of Air Law and Commerce*, vol. 37, no. 1, 1971, p. 65-87. 193 refs.

Prompted by the ever-growing trend toward acquisition of diversified business economic interests by single-corporate entities, Congress recently amended the Federal Aviation Act making it unlawful for any person to acquire a controlling interest in an air carrier without approval of the Civil Aeronautics Board. Issue is taken with the amendment for creating more problems than it solved. Noting that the legislation conferred unnecessarily broad powers on the CAB, guidelines are suggested for persons acquiring a substantial stock interest or otherwise assuming an influential relationship with an airline. A sensible approach to the new statute is suggested.

M.M.

A71-42072 Improving the efficiency of airports. Richard H. Byers, Charles B. Shields, and Raymond E. Thompson. *Battelle Research Outlook*, vol. 3, no. 2, 1971, p. 7-12.

The considerations underlying the design of an airport required to cope with passenger and baggage accommodation problems of the type created by the advent of Jumbo Jets like the Boeing 747 are outlined. Factors affecting the choice between a continuous type and a batching intra-airport type transit system are examined. An integrated system being installed at the Seattle-Tacoma airport is described and analyzed.

V.P.

A71-42073 For a better, short-haul flight. John W. Chadwick, Richard F. Porter, and Ellis F. Hitt. *Battelle Research Outlook*, vol. 3, no. 2, 1971, p. 18-21.

Short-haul air transportation is discussed as an outstanding example of the need for cooperation among many disciplines to solve what once would have been a largely technological problem. All that

technology has to offer cannot be put to use until critical social questions have been answered and Government policies have been established. At the same time, the economics and goals of the communities, the industry concerned, and the aviation industry itself must be subjected to serious consideration. Only then can the necessary technology be focused to produce the hardware and procedures that fit the needs of the entire short-haul system. V.P.

A71-42075 **Avoiding hydraulic-system failure.** A. A. Nemechek (Lockheed-California Co., Burbank, Calif.). *Machine Design*, vol. 43, Sept. 30, 1971, p. 53-57.

The developments and progress in on-condition monitoring (OCM), which consists in instrumenting a hydraulic system so that changes in critical operating parameters are noted as indicators of component deterioration, are reviewed by examining the basic features of some OCM systems previously and currently used to check aircraft hydraulic systems. The systems examined are: BITE (built in test equipment), TARAN (test and repair as necessary), and the advanced AIDS (airborne integrated data system) which permits the monitoring of hydraulic equipment during flight. Some hydraulic system innovations in the Boeing 747, the Lockheed L-1011, and the DC-10 are discussed. V.P.

A71-42077 **The role of navigation in airways systems development; Proceedings of the National Air Meeting, Saddle Brook, N.J., April 14-16, 1971.** Meeting sponsored by the Institute of Navigation. Washington, D.C., Institute of Navigation, 1971. 327 p. Members, \$10.00; nonmembers, \$15.

Topics discussed include a quantitative evaluation of the performance of an inertially aided area navigation system, a description of a carrier aircraft inertial navigation system, the use of the OMEGA system in airborne applications, an analytical model for performance analysis of a regional air traffic control system, the interdependence of navigation and surveillance in ATC, new UTC time signals, a one-way step-scan microwave landing guidance system, a high-scanning-rate Doppler-scanning landing guidance system, the design of a microwave scanning-beam aircraft guidance system, design considerations for oceanic satellite systems, and a satellite air traffic control center for the North Atlantic.

A.B.K.

A71-42078 # **Technology of tomorrow's commercial air traffic control.** William G. Denhard (MIT, Cambridge, Mass.). In: *The role of navigation in airways systems development; Proceedings of the National Air Meeting, Saddle Brook, N.J., April 14-16, 1971.* Washington, D.C., Institute of Navigation, 1971, p. 1-21. 8 refs.

Air traffic control today depends on radio, radar, and human interpretation thereof. In bad weather, with enlarged air blocks, delays of one to two hours are common, and four-to-eight-hour delays are not uncommon. Were there a means to continuously identify longitudinal position of each aircraft to the order of a few hundred feet on the ground and 1/2 nautical mile in the air (and even closer on landing and takeoff), and velocity to the order of 1/2 foot per second, most delays would disappear since aircraft would operate under better than VFR conditions and with improved flight-control inputs. The economic benefits to the airlines in delay time saved would provide a basis for funding the equipment to work the problem in these terms. Tomorrow's commercial inertial navigation can be expected to perform with accuracy measured in hundreds of feet. Using such a system, one can envisage each aircraft knowing its coordinates, velocity, etc., and so informing the air-traffic-control center via data links with the whole operation at computer speeds.

(Author)

A71-42079 # **The impact of inertial navigation on air safety.** R. M. Hershkowitz, D. O'Mathuna (U.S. Department of Transportation, Cambridge, Mass.), and K. R. Britting (MIT, Cambridge, Mass.).

In: *The role of navigation in airways systems development; Proceedings of the National Air Meeting, Saddle Brook, N.J., April 14-16, 1971.* Washington, D.C., Institute of Navigation, 1971, p. 23-46. 12 refs.

An analysis of inertial navigation system performance data was carried out to assess the probable impact of inertial navigation on the aircraft collision risk in the North Atlantic region. The data base used for this study consisted of terminal accuracy data collected by Air France between July 1968 and April 1970 using the Litton LTN 51 system. These data were used to calculate the collision-risk between two aircraft flying at the same nominal flight level on adjacent tracks. The generally conservative assumptions used in adapting the data base to the collision risk formulae are explained and justified, and the mathematical techniques used in deriving the collision risk results are derived and discussed. The inertial system's error sources are treated in a statistical sense to infer the en route error behavior from the terminal error data. Collision risk estimates are derived for easterly and westerly transatlantic flights. The tails of the probability distribution associated with the terminal errors were modeled using both Gaussian and first Laplacian assumptions. The results of this relatively conservative analysis shows that there is strong evidence to support the concept that the widespread use of inertial navigators will lead to reduce separation standards in the North Atlantic region while maintaining present safety standards. (Author)

A71-42080 # **Area navigation - A quantitative evaluation of the effectiveness of inertial system aiding.** Marvin Silver and Melvyn Greenberg (Singer-General Precision, Inc., Wayne, N.J.). In: *The role of navigation in airways systems development; Proceedings of the National Air Meeting, Saddle Brook, N.J., April 14-16, 1971.* Washington, D.C., Institute of Navigation, 1971, p. 47-63.

The contribution of an inertial navigation system (INS) combined with present and projected VOR/DME to the accuracy and efficiency of area navigation is evaluated by comparing system performance with and without INS aiding. Sensitivity to INS quality is described by showing area navigation performance using high and medium accuracy production INS. The increased accuracy of the INS aided area navigation system is evaluated with respect to its impact on decreasing the protective airspace requirements, greater waypoint location flexibility, and increased accuracy of vertical navigation between waypoints. To complete the description of an inertially aided AREA-NAV system, the basic computational techniques and trade-offs for optimally mixing sensor information are presented.

(Author)

A71-42081 # **CAINS - Pointing to the future.** Ronald S. Vaughn (U.S. Naval Material Command, Naval Air Development Center, Warminster, Pa.). In: *The role of navigation in airways systems development; Proceedings of the National Air Meeting, Saddle Brook, N.J., April 14-16, 1971.* Washington, D.C., Institute of Navigation, 1971, p. 65-79.

The CAINS (Carrier Aircraft Inertial Navigation System) was developed as a second generation fleet aircraft inertial navigation system. A system design approach not only assured that inertial navigation accuracy consistent with the state-of-the-art would be achieved, but that system reliability and maintainability would be enhanced. A primary goal in the development of CAINS was a rapid reaction capability, which utilizes both thermal modeling and statistically filtered alignment modes. By virtue of the rapid reaction requirement, a digital data link system was developed for input of reference navigation data aboard ship. This data link capability has been utilized for vectoring information as well. The mode flexibility of CAINS as a central aircraft navigation system suggests other uses of the data link for tactical navigation modes. The CAINS system represents the first step in a break of the traditional position of the INS (Inertial Navigation Set) as an exclusively self-contained navigation system. (Author)

A71-42082 # Evaluation of OMEGA configurations for airways system operations. Joseph F. Kasper, Jr. (Analytic Sciences Corp., Reading, Mass.). In: The role of navigation in airways systems development; Proceedings of the National Air Meeting, Saddle Brook, N.J., April 14-16, 1971. Washington, D.C., Institute of Navigation, 1971, p. 81-95. 27 refs. Department of Transportation Contract No. DOT-CG-94331-A; Contract No. N 62306-71-C-0030.

Utilization of the OMEGA radio navigation system in airborne applications is considered. A brief description of the system is given with particular emphasis on the various OMEGA configurations. Three of these are discussed with regard to accuracy and suitability for airways operations. They are unaided OMEGA, integrated OMEGA/Inertial and Differential OMEGA. Actual OMEGA phase data are used in the accuracy analyses, along with empirically-derived spatial and temporal correlation models for OMEGA errors. A potential for OMEGA utilization is indicated; recommendations for additional studies in this area are given. (Author)

A71-42083 # Analytical model for navigation and air traffic control. John C. Hansen and David J. Maxwell (Computer Sciences Corp., Falls Church, Va.). In: The role of navigation in airways systems development; Proceedings of the National Air Meeting, Saddle Brook, N.J., April 14-16, 1971. Washington, D.C., Institute of Navigation, 1971, p. 97-114. 5 refs.

This paper presents an analytical model which may be applied in the performance analysis associated with the system design of an ATC system for the NAT region. The model is formulated and exercised to demonstrate the effect of several parameters on lateral separation standards for parallel flight lanes. The introduction of a satellite navigation and communication system together with a self-contained inertial navigation system allow a substantial reduction in lateral separation. (Author)

A71-42084 # A status report on the Army's developments associated with air traffic management. Harold H. Bahr and John C. Cittadino (U.S. Army, Fort Monmouth, N.J.). In: The role of navigation in airways systems development; Proceedings of the National Air Meeting, Saddle Brook, N.J., April 14-16, 1971. Washington, D.C., Institute of Navigation, 1971, p. 115-130.

This paper addresses the Army's approach to air traffic management. The objective is to provide the Army with the most cost-effective system which will permit high densities of aircraft to operate, flying at low altitudes to avoid enemy radar, under day/night and near-all weather conditions. The unique aspects of Army helicopter tactical operations are discussed as well as a model of the operational environment. An examination is made of the input factors as well as the systems engineering approach being followed to ensure that the various functions of the Army's air traffic management system are addressed on an integrated basis. (Author)

A71-42085 # Interaction of navigation and surveillance in air traffic control. Thomas W. Jerardi and Leo F. Fehlner (Johns Hopkins University, Silver Spring, Md.). In: The role of navigation in airways systems development; Proceedings of the National Air Meeting, Saddle Brook, N.J., April 14-16, 1971. Washington, D.C., Institute of Navigation, 1971, p. 135-149. 7 refs.

The authors discuss the concept of 'independent navigation and surveillance.' Several operational examples are given, and these cases are used to illustrate the interdependence of navigation and surveillance. The authors conclude by posing a question as to the merits of the independence requirement as set forth by the 'Project Beacon' Task Force and the Alexander Committee. (Author)

A71-42086 # Design considerations for an integrated communication, navigation, identification system. Ralph L. Asher (ITT,

ITT Avionics Div., Nutley, N.J.). In: The role of navigation in airways systems development; Proceedings of the National Air Meeting, Saddle Brook, N.J., April 14-16, 1971.

Washington, D.C., Institute of Navigation, 1971, p. 151-163. 12 refs.

It is inevitable that an integrated communication, navigation, identification (ICNI) system will be eventually implemented as a part of our airways system. The rapid growth of air traffic forecast for the balance of the century and the great strides being achieved in technology make it appropriate to commence development of such a system at this time. The design of such a system must be constrained by a number of technical and economic factors. Among these are an economically feasible implementation plan, a selection of spectrum, a high degree of operational flexibility and a broad capability of functional performance. (Author)

A71-42088 # TALAR - A modular step scan microwave landing system. George Henf (Singer-General Precision, Inc., Pleasantville, N.Y.). In: The role of navigation in airways systems development; Proceedings of the National Air Meeting, Saddle Brook, N.J., April 14-16, 1971. Washington, D.C., Institute of Navigation, 1971, p. 175-189.

The operational experience and recent evaluation data pertaining to the performance of TALAR, a step scanned microwave landing system is reviewed. The data reviewed covers a period of approximately 10 years. The basic functional operation of a step scan system is described - i.e., TALAR. A family of landing systems is then derived via modular interchange with the base line unit. Operational configurations such as short take off and landing, asynchronous split site, multiangle and multichannel are described. (Author)

A71-42089 # Doppler Scanning Landing Guidance System development. Henry W. Redlien and Raymond J. Masak (Hazeltine Corp., Greenlawn, N.Y.). In: The role of navigation in airways systems development; Proceedings of the National Air Meeting, Saddle Brook, N.J., April 14-16, 1971. Washington, D.C., Institute of Navigation, 1971, p. 191-205.

Description of the Doppler Scanning Landing Guidance System (LGS), a microwave system for providing air-derived azimuth and elevation angle guidance by simultaneously frequency coding space over wide coverage angles. Angle guidance is derived in the air by the measurement of the Doppler shift of the radiated frequency relative to a nonmoving reference carrier transmission. Frequency coding is provided by effectively moving a small, wide-angle radiating antenna along a track perpendicular to the runway centerline to provide a Doppler-shifted, angle-dependent frequency. The system has inherently very rapid scanning. F.R.L.

A71-42090 # The choice of coordinates for microwave landing system. Lon L. Sanders (ITT Gilfillan, Inc., Van Nuys, Calif.). In: The role of navigation in airways systems development; Proceedings of the National Air Meeting, Saddle Brook, N.J., April 14-16, 1971. Washington, D.C., Institute of Navigation, 1971, p. 207-235.

Comparison of the various factors involved in choosing coordinates for the microwave landing guidance system. The technical uncertainties concerning the data rate and antenna beamwidth requirements indicate a desire for the format to accommodate electronically scanned antennas and the associated conical beam shapes. The performance limitations and the complexity of computing elevation paths indicate a desire to preserve the planar beams formed by mechanically scanned antennas. An analysis of the impact of conical coordinates on various airport equipment configurations and aircraft avionics installations is presented. It is concluded that a signal format with provision for either planar or conical beams can minimize the risk of the technical uncertainties in the format. F.R.L.

A71-42091 # Radio guidance using microwave scanning beams. George B. Litchford (Litchford Systems, Northport, N.Y.). In: The role of navigation in airways systems development; Proceedings of the National Air Meeting, Saddle Brook, N.J., April 14-16, 1971. Washington, D.C., Institute of Navigation, 1971, p. 237-251.

Technical matters that must be optimized in the design of a scanning-beam guidance system are typified by: beamwidth; beam geometry; sampling rates; beam velocity; 'dwell times'; modulation techniques to encode angle data on the beam; and the choice of microwave frequency. The design of an aircraft landing guidance receiver and pilot displays suited to the sequential reception of short 'bursts' of precision angle data from several scanning-beam ground sources of elevation and azimuthal guidance will be outlined. Several operational and user advantages derived from the application of this new technology will be noted. (Author)

A71-42092 # A survey of microwave guidance problems related to the operational requirements. J. Benjamin and P. G. Reich (Royal Aircraft Establishment, Farnborough, Hants., England). In: The role of navigation in airways systems development; Proceedings of the National Air Meeting, Saddle Brook, N.J., April 14-16, 1971. Washington, D.C., Institute of Navigation, 1971, p. 253-269.

Several organizations, civil and military, have produced operational requirements for guidance systems suited to the foreseeable long term needs of aviation. The envelope of these requirements is examined and related to the technical problems and possible solutions. By far the most important common feature is seen to be the change of emphasis from 'guidance' to 'position measurement' and this will demand corresponding innovation in both aircraft and Air Traffic Control instrumentation. A number of fundamental problems of microwave systems are examined. There are sources of difficulty that will arise in practice and which may preclude the full range of requirements from being satisfied. Programs of evaluation to provide fundamental measurements of performance and to examine all the newly proposed operational aspects should be carried out in advance of a definitive system design. (Author)

A71-42096 # Department of Transportation Federal Aviation Administration planning and programming for aeronautical satellite systems in oceanic applications. Horace O. Adams (FAA, Washington, D.C.). In: The role of navigation in airways systems development; Proceedings of the National Air Meeting, Saddle Brook, N.J., April 14-16, 1971. Washington, D.C., Institute of Navigation, 1971, p. 323-331.

Discussion of program planning for aeronautical satellite systems which will lead to improved communications, air traffic control, and other services in airspace over oceanic areas. Information is provided on previous aeronautical satellite effort; the DOT/FAA Management Structure for the satellite program; a view of improvements needed in providing oceanic air traffic services; and a preliminary program and plan for implementing the improvements. F.R.L.

A71-42151 An infra-red aerial survey equipment operating in the 3.0 to 5.5 micrometre band. E. S. Kingston (EMI Electronics, Ltd., Feltham, Middx., England). In: Joint Conference on Infra-Red Techniques, University of Reading, Reading, Berks., England, September 21-23, 1971, Proceedings. London, Institution of Electronic and Radio Engineers, 1971, p. 365-376.

Infrared (3.0 to 5.5 microns) airborne equipment for commercial aerial survey applications is described in terms of scanner, recorder, cooling-system, display, and power-supply features. The detector consists of photoconductive indium antimonide operated at 77 K, and the resolution ranges from 1.3 to 6.7 milliradians, depending on the size of the detector element employed. Typical survey results obtained over various types of terrain, inland lakes, rivers, and coastal areas are discussed. T.M.

A71-42224 # Agusta 109 'Hirundo' (Agusta 109 'Hirundo'). Gianfranco Rotondi. *Alata Internazionale*, vol. 27, Sept. 1971, p. 43-50. In Italian.

Discussion of the design and testing criteria of this latest Agusta helicopter. The four-blade rotor has been especially engineered to allow elevated flying speeds. The fuselage has been built in accordance with very advanced construction techniques and combines a large internal volume with minimum external overall dimensions, as well as sturdiness and rigidity. Particular care has been devoted to the radionavigation equipment which makes it possible to use the IFR system. Possible combat uses call for equipping the helicopter with four remotely controlled missiles, two rocket launchers, two machine guns, and two miniguns. M.M.

A71-42235 # Increasing efficiency at airports. *Aircraft Engineering*, vol. 43, Sept. 1971, p. 15, 17.

Review of innovations introduced at some airports to improve their operational efficiency. A Muirhead Sendox system of internal document delivery introduced at London Heathrow Airport, a pneumatic ground power source for towing Boeing 747 aircraft introduced by Aer Lingus, high-temperature test trolleys for supersonic flight, underground jet-stand compressors used at Sydney Airport, Lithurn hangar floor coating used at the East Midlands Airport, and unit air conditioning plant units ordered by the British Ministry of Defence are covered. V.Z.

A71-42236 # European A300B airbus. *Aircraft Engineering*, vol. 43, Sept. 1971, p. 18-20, 22, 23 (7 ff.).

The design features and performance characteristics of the Airbus are discussed. The electrical system, flying control, air conditioning, fuel systems, and C56-50A engines of the craft are covered. Details are given on the constant speed drive, the flying control circuits, the rudder, tailplane, airbrake, lift dump and flaps and leading-edge slats control systems. Further topics include the servocontrols, radio compass, compressor, combustor, high and low pressure turbines, and the bearings and seals of the engines. An exploded drawing of the craft with indexed components is included. V.Z.

A71-42237 The future of aeronautics - Dreams and realities. John E. Allen (Hawker Siddeley Aviation, Ltd., Kingston-upon-Thames, England). *Aeronautical Journal*, vol. 75, Sept. 1971, p. 587-607; Discussion, p. 607-609. 77 refs.

It is possible to identify five zones of the future within which quite different processes exist for progressing into novel aeronautical techniques and systems. The first three zones include very short term improvements, applicable research, and long term research. When considering Zone 4 one may postulate technical progress but one must take due note of nonaeronautical happenings. The reconsideration of the turbopropeller using Hyfil blades for quiet STOL duties is cited as an example of the Future Historic Zone 5. G.R.

A71-42238 The case for the convertible rotor (Tenth Cierva Memorial Lecture). R. Hafner. *Aeronautical Journal*, vol. 75, Sept. 1971, p. 610-625; Discussion, p. 626, 627.

The rotor performance is computed for the two modes of VTOL flight, hover, and cruise. The different conditions in the two modes of operation demand variable blade geometry in terms of blade twist, as well as aerofoil camber. The high thrust in the hover mode must be obtained with a minimum of blade area to avoid excessive drag in the cruise mode. To achieve this a fairly high tip speed must be combined with high lift coefficients. In the cruise mode on the other hand, tip speed, and lift coefficients must be reduced considerably. This leads to a high advance ratio. G.R.

A71-42239 Keeping the pilot happy - The contribution of research and development (Third Sir Geoffrey de Havilland Memorial Lecture). Morien Morgan (Royal Aircraft Establishment, Farnborough, Hants., England). *Aeronautical Journal*, vol. 75, Sept. 1971, p. 630-647. 13 refs.

Aspects of handling research during the years from 1935 to 1945 are related together with problems which had to be solved during the war years, giving attention to combat operations, accident prevention, and improvements in the basic understanding of the handling characteristics of military aircraft. Current work discussed includes the development of handling criteria, work in the Avionics Department, and investigations concerned with the pilot in order to improve his personal equipment. G.R.

A71-42240 Parametric oscillations in aircraft structures. A. D. S. Barr and G. T. S. Done (Edinburgh, University, Edinburgh, Scotland). *Aeronautical Journal*, vol. 75, Sept. 1971, p. 654-658. 8 refs.

Parametric vibration is a generic term for the oscillatory type of motion which can occur in a structure having time dependent variation of its parameters such as its inertia or stiffness. Aspects of parametric instability are analyzed and autoparametric instability is considered. Various aspects of aircraft dynamics are studied, the aspects chosen being the few known or thought to be significant in the realm of parametric oscillations. G.R.

A71-42286 Evaluation of the takeoff and landing performance of commercial STOL aircraft (Valutazione delle prestazioni di decollo e atterraggio dei velivoli civili STOL). Mario Calcarà (Industrie Aerospaziali Meridionali S.p.A.; Napoli, Università, Naples, Italy). *L'Aerotecnica - Missili e Spazio*, vol. 50, Apr.-June 1971, p. 113-125. 5 refs. In Italian.

Brief discussion of the basic requirements for commercial STOL aircraft and of the current trend of manufacturers toward the use of high bypass ratio turbofans and very advanced high lift systems. A computational method is developed for the quick evaluation of takeoff and landing performance, allowing for an easy comparison of different configurations. The method takes into account safety requirements such as speed maneuvering margin, critical engine failure at takeoff, landing field length factor, passenger comfort, and pilot limitations due to the human factor. The method is illustrated by means of a numerical example. M.M.

A71-42288 Extension of the lifting line theory to low aspect ratio wings (Estensione della teoria della linea portante alle ali di basso allungamento). Valentino Losito (Napoli, Università, Naples, Italy). *L'Aerotecnica - Missili e Spazio*, vol. 50, Apr.-June 1971, p. 134-138. 16 refs. In Italian.

After underscoring the limitations connected with the use of the conventional lifting line theory, a formulation is proposed for Prandtl's integral equation using a suitable reducing function for the local angle of downwash with respect to the corresponding value at infinity. It is thus possible to evaluate accurately the aerodynamic loads also for very low aspect ratio wings within the scope of a linear theory. M.M.

A71-42289 Kalman-Bucy filter for air navigation by means of VOR/DME and air data system (Un filtro di Kalman-Bucy per navigazione aerea mediante VOR/DME e air data system). Aleramo Lucifredi (Genova, Università, Genoa, Italy). *L'Aerotecnica - Missili e Spazio*, vol. 50, Apr.-June 1971, p. 139-143. 9 refs. In Italian.

Examination of the VOR/DME air navigation equipment, and description of the mechanization of a Kalman-Bucy filter in order to improve its accuracy through velocity measurements available from an airborne AIR DATA SYSTEM (ADS). The Markov model shows an example of solution of a problem with nonlinearities in the measurements, and represents the ADS errors as colored noises,

whereas the VOR and DME errors are represented as the sum of a constant random term plus a white noise. Numerical data pertinent to such errors are given, together with the filter formulas, both for the case of continuous and for that of intermittent measurements.

M.M.

A71-42396 Mathematical models for automatic flight-tracking procedures (Mathematische Modelle für automatische Flugverfolgungsverfahren). H. Hönerloh (Gesellschaft zur Förderung der astrophysikalischen Forschung, Forschungsinstitut für Funk und Mathematik, Wachtberg-Werthhoven, West Germany). *Angewandte Informatik*, Sept. 1971, p. 429-433. In German.

Discussion of mathematical models for a group of aircraft tracking logics without smoothing of tracks. These logics are described by systems of transient equations which make it possible to calculate the mean numbers of true and false tracks. As a measure of tracking reliability, a definition is given of the tracking probability and the latter is used for comparing the merits of the various tracking procedures considered. The models make it also possible to calculate the storage capacity requirements the used computer should meet.

M.V.E.

A71-42400 # Report about the Alcyon project - PTA 1 (Compte rendu de la campagne Alcyon - PTA 1). R. Régipa and M. Rougeron (Centre National d'Etudes Spatiales, Toulouse, France). *SPARMO Bulletin*, vol. 4, July 1971, p. 321-333. In French.

In March 1970, six Alcyon balloon systems were launched from Pretoria, South Africa. An Alcyon system includes a zero pressure balloon and a superpressure spherical balloon with a GHOST gondola. The objectives of the investigation were to test the stabilization efficiency of the Alcyon system during the transition between night and day. The results obtained demonstrate the suitability of the system for scientific studies. However, some technical improvements are required to enhance system reliability.

G.R.

A71-42427 Aircraft propulsion. P. J. McMahon (Bath University of Technology, Bath, Somerset, England). London, Sir Isaac Pitman and Sons, Ltd., 1971. 389 p. 74 refs. \$9.00.

The fundamentals of aircraft propulsion are presented in a form suitable for the practicing engineer and operator as well as for the student. In addition, emphasis is laid on the design aspects of the work and the conflicting requirements which must be reconciled in order to produce worthwhile engines and components. Topics discussed include propulsion cycles, gas turbine compressors, the expansion system of turbine engines, combustion systems for turbine engines, the installation of aircraft engines, engine dynamics and control, the ramjet engine, rocket propulsion, the piston aircraft engine, mechanical and material considerations in the design of turbine engines, and basic flight vehicle performance. A.B.K.

A71-42527 # Breaking the automobile barrier in ultra-short-haul transportation. Rene H. Miller (MIT, Cambridge, Mass.). *Astronautics and Aeronautics*, vol. 9, Oct. 1971, p. 68-77. 17 refs.

The distribution of travel among private automobile, common-carrier transit systems, and taxi within a major city is examined, taking into consideration as an example the conditions in Boston. The hidden costs of the widespread use of the automobile in intercity traffic are community disruption, destructive pollution, traffic congestion, and land loss. Common-carrier systems such as bus, rail and rapid transit have not succeeded in alleviating the problems associated with automobile travel. Economic and technical factors are analyzed to explore the potential of air systems competing with the auto over distances greater than 5 mi, taking into account the true costs of the automobile. The new breed of V/STOL aircraft can be quieter than ambient city noises. It is pointed out that replacing automobiles by common-carrier air transportation would also be highly desirable to reduce the pollution of the atmosphere in urban and suburban areas. G.R.

A71-42594 Corrosive delamination. Frank J. Riel (Rohr Corp., Chula Vista, Calif.). (U.S. Air Force Materials Laboratory and Society of Aerospace Material and Process Engineers, Air Force Materials Symposium, Miami Beach, Fla., May 18-22, 1970.) *SAMPE Journal*, vol. 7, Aug.-Sept. 1971, p. 16-20.

Discussion of the findings of an extensive test program for developing a basic understanding of corrosive delamination: (1) a significant factor in corrosive delamination of adhesive bonded structures is galvanic corrosion occurring between dissimilar metals or alloys in the selected configuration; (2) corrosive delamination will occur whenever the adhesive is bonded to a thin film of an alloy which is anodic, with respect to the remainder of the metallic structure, providing that an electrolyte is simultaneously in contact with both the anodic and the cathodic alloy; (3) corrosive delamination can be reduced substantially by avoiding the occurrence of the circumstance outlined in (2); and (4) where nonclad alloys are used in areas exposed to corrosive environments, the exterior surface must be protected by appropriate means in order to limit surface corrosion. M.M.

A71-42681 # Plane air jets expelled into a blind alley (Istechenie ploskoi vozdukhnoi strui v tupik). E. P. Dyban, A. I. Mazur, and E. Ia. Epik (Akademii Nauk Ukrainskoi SSR, Institut Tekhnicheskoi Teplofiziki, Kiev, Ukrainian SSR). *Inzhenerno-Fizicheskii Zhurnal*, vol. 20, June 1971, p. 1020-1026. 6 refs. In Russian.

Flow visualization experiments with jets expelled from two-dimensional nozzles into plane-parallel and parabolic type closed ducts revealed the existence of two flow modes in a plane-parallel duct: a symmetrical mode and a mode characterized by unilateral sticking of the jet. In plane-parallel ducts with length-to-width ratios from 1.5 to 7.6, the jet in the symmetrical mode has no initial length and its range does not exceed 1.5 nozzle widths. The configuration and length of the duct, the initial turbulence of the flow, the Reynolds number, and the counterpressure at the outlet of the duct have no appreciable effect on the flow. V.P.

A71-42766 # Low speed aerodynamics and the Science Council's National Goals. R. J. Templin (National Aeronautical Establishment, Ottawa, Canada). *Canada, National Research Council, Division of Mechanical Engineering and National Aeronautical Establishment, Quarterly Bulletin*, no. 2, 1971, p. 1-15, 17-20.

This article describes some of the details and the results of a paper exercise carried out sporadically since November 1970. A simple version of the so-called 'relevance tree' forecasting method was used to relate the Science Council's list of National Goals to relevant research gaps in low speed aerodynamics. The exercise was performed mainly out of curiosity, partly as to the nature of the method itself, and partly as to the results it can produce. The numerical results of the 'relevance' marking system used appear to be sensitive to individual judgment, and may merely indicate which bandwagon the scorer prefers. On the other hand, the relevance tree provides a simple graphic display of the possible connections between specific research areas, and broad national goals. Enough details are given to permit the reader to use his own judgment.

(Author)

A71-42787 * # Injection into a supersonic stream from the windward side of sweptback injectors at angle of attack. M. Hersch and L. A. Povenelli (NASA, Lewis Research Center, Hypersonic Propulsion Section, Cleveland, Ohio). *Journal of Spacecraft and Rockets*, vol. 8, Oct. 1971, p. 1101-1103. 5 refs.

The technique of windward injection into the supersonic stream was used to minimize vortex disruption and permit greater capture of the vortex by the jet. With windward injection using configurations A and B mounted at 18 and 22 deg angle of attack, respectively, helium was carried over the swept edge and captured by the leeward vortex. No helium was detected over the leeward side of configura-

tion A at 12 deg angle of attack using windward injection. This indicates that a minimum angle of attack is needed for helium to be carried from the windward to leeward regions. It is noted that windward injection might be a useful injector-cooling technique.

M.M.

A71-42832 # Some considerations relative to the prediction of unsteady air loads on lifting configurations. Holt Ashley (Stanford University, Stanford, Calif.). *Journal of Aircraft*, vol. 8, Oct. 1971, p. 747-756. 37 refs. Contract No. AF 44(620)-68-C-0036.

Discussion of a personal viewpoint on several fundamental issues whose understanding is expected to contribute to improved unsteady lifting surface and interference theory. The position adopted is that the subject under discussion should properly include control surfaces and similar devices which create slope discontinuities or gaps in the geometry of otherwise nearly planar lifting systems. The first question addressed is that of loading singularities inherent in linearized potential theory. They are classified as: (1) local, in the sense that both the nature and magnitude of the singularity are determined by boundary conditions in the 'inner field'; or (2) global, in the sense that the entire boundary value problem must be solved to determine their details. Results are reviewed relative to discontinuities in surface slope, planform shape, dihedral angle, and suggestions are made for combining them into numerical solution schemes. M.M.

A71-42833 * # Flight investigation of the influence of turbulence on lateral-directional flying qualities. James A. Franklin (Princeton University, Princeton, N.J.; NASA, Ames Research Center, Flight and Systems Research Branch, Moffett Field, Calif.). *Journal of Aircraft*, vol. 8, Oct. 1971, p. 795-802. 5 refs. Contract No. NSR-31-001-104.

Flight evaluations using a variable stability airplane were made to determine the independent and interacting effects of simulated turbulence disturbances and lateral-directional dynamics on flying qualities associated with a precision heading control task. Turbulence was described in terms of rms roll and yaw disturbance magnitude, correlation between roll and yaw disturbances, and the bandwidth of the turbulence power spectrum. Variations in dynamics included roll damping, directional stability, and Dutch roll damping. Trends in pilot rating obtained in the test program with variations in turbulence disturbances and airplane dynamics are explained in terms of measures of precision of task performance, pilot control workload, and pilot compensatory behavior derived from time histories of the flight evaluations. (Author)

A71-42834 # Comparison of constant lift-coefficient climbs with flight-manual climbs for a jet transport. Frederick Y. Thomasson and Gerald Cook (Virginia University, Charlottesville, Va.). *Journal of Aircraft*, vol. 8, Oct. 1971, p. 810-812. Research sponsored by Teledyne.

Aircraft climb trajectories utilizing a constant lift coefficient are investigated for the KC-135. Analytical and numerical approaches are presented. The objective is to climb to a prespecified altitude with a given amount of fuel and maximize the range. The optimum constant C_{L} is determined and the corresponding trajectory compared with that resulting from flight-manual climbs. Although the constant C_{L} strategy is easy to implement, its resulting efficiency is not as great as that resulting from the flight-manual climb. (Author)

A71-42836 # Dynamic performance characteristics of mixed and unmixed turbofan engines. Franz N. Fett. *Journal of Aircraft*, vol. 8, Oct. 1971, p. 820-825. 7 refs.

Mixed and unmixed type turbofans, having identical rotating components and thermodynamic cycles, are compared in terms of transient characteristics and steady-state off-design operation. Effects of step changes in fuel flow rate, nozzle area, inlet pressure, ambient

temperature and air bleed are illustrated on both the fan and compressor operating maps. Results show significant differences in the dynamic behavior of the mixed and unmixed turbofan engines without the influence of an engine control. Off-design steady-state operating points are also different. Both effects are more pronounced in the low-pressure fan than in the high-pressure compressor. Such characteristics are important in the design of a compatible engine control unit. (Author)

A71-42837 # Effect of oxygen concentration on the thermal stability of naphthenes. H. T. Henderson and A. C. Nixon (Shell Development Co., Emeryville, Calif.). *Journal of Aircraft*, vol. 8, Oct. 1971, p. 831-834. 11 refs. Contracts No. AF 33(657)-11096; No. AF 33(615)-3789.

Investigation of the thermal stability of prototype fuels at temperatures up to 1000 F in connection with the possible use of hydrocarbons as fuels for hypersonic aircraft. The presence of oxygen has a deleterious effect on the observed thermal stability, as measured by a high-temperature coker, even at concentrations in the sub-ppm region. After developing a GLC method for determining oxygen in hydrocarbons down to 10 ppb, the effect of O₂ was explored with decalin at concentrations down to the level of detection. No effect was noted at O₂ concentrations up to about 3 ppm, but thereafter it was found that thermal stability decreased rapidly with increasing equilibrium oxygen concentration in the range up to about 10 ppm, more slowly up to about 15 ppm, and showed little subsequent response up to the saturation limit (about 300 ppm). Methylcyclohexane and a naphthenic jet fuel were not investigated as completely, but demonstrated somewhat similar but individual behaviors. It appears that the depositing tendency of the fuel is generally related to the basic kinetics of the oxidation of hydrocarbons but the reasons for the idiosyncracies of individual hydrocarbons are obscure. (Author)

A71-42838 # Solution of the lifting line equation for twisted elliptic wings. L. T. Filotas (Maryland, University, College Park, Md.). *Journal of Aircraft*, vol. 8, Oct. 1971, p. 835, 836.

An exact inversion of the lifting line equation for wings of elliptic planform with arbitrary spanwise upwash is provided. The formula is applied to the example of a sinusoidally twisted wing as originally introduced by Prandtl and Betz (1927). The result is compared with Prandtl's result for the infinite lifting line. The circulation around the midspan section of a sinusoidally twisted lifting line is shown in a graph. G.R.

A71-42839 # Turbulent skin friction for tapered wings. Richard Ross. *Journal of Aircraft*, vol. 8, Oct. 1971, p. 836, 837.

The method discussed for the determination of skin-friction drag is derived on the basis of Reynolds numbers referred to the wing root-chord. An expression for the local skin friction is obtained from the Prandtl-Schlichting turbulent skin-friction formula for a smooth plate. The local skin-friction coefficient is presented as a function of the root-chord Reynolds number and planform geometry. A series approximation derived is found to be nearly exact, differing from strip integrated values by only 0.4% for the worst case. G.R.

A71-42840 # Convergence-proof of discrete-panel wing loading theories. John DeYoung (Texas, University, Arlington, Tex.). *Journal of Aircraft*, vol. 8, Oct. 1971, p. 837-839.

An equation for the chordwise vorticity is derived. The equation gives the chordwise additional (or noncambered wing) loading in terms of circulation at N equal length panels or segments along the wing chord. The formula can be used to prove mathematically that finite element loading methods converge on the exact answer as the number of elements are increased. Factors for chordwise loading are considered. The factors can be applied directly to finite aspect ratio

lifting surface theories that are based on elemental horseshoe vortices, constant vorticity panels, or for multiple load and downwash lines. G.R.

A71-42841 # Effect of unsteady pressure gradient reduction on dynamic stall delay. Franklin O. Carta (United Aircraft Research Laboratories, East Hartford, Conn.). *Journal of Aircraft*, vol. 8, Oct. 1971, p. 839-841. 9 refs.

A possible theoretical mechanism for the delay in dynamic stall is discussed. The theory is confined to a comparison of the unsteady and quasi-steady chordwise potential flow pressure distributions. It is shown that the unsteady pressure gradient over the forward portion of the airfoil is less unfavorable than the steady pressure gradient. Hence it can be inferred that a measurable stall margin exists for an unsteady motion relative to the steady state stalling angle, and that this stall margin increases with frequency. G.R.

STAR ENTRIES

N71-34001*# North American Rockwell Corp., Los Angeles, Calif.

ESTIMATED PERFORMANCE AND STABILITY AND CONTROL DATA FOR CORRELATION WITH XB-70-1 FLIGHT TEST DATA

John H. Wykes and Robert E. Lawrence Jul. 1971 491 p refs (Contract NAS2-6037)

(NASA-CR-114335) Avail: NTIS CSCL 01B

The results of a study program established by NASA to provide supporting information for correlation studies based on small-scale rigid-model wind tunnel test data and results from flight tests of the XB-70-1 airplane are reported. The ultimate objective of the overall program is to validate with flight results combined analytical and wind tunnel test techniques for determining performance, stability, and control characteristics of flexible aircraft. Author

N71-34002# Royal Netherlands Aircraft Factories Fokker, Amsterdam.

T-TAIL AEROELASTIC ANALYSIS FOR FOKKER F-28

J. Yff and R. J. Zwaan [1970] 22 p refs Presented at the AGARD Symp. for Unsteady Aerodynamics for Aeroelastic Analyses of Interfering Surfaces, Tonsberg, Oslofjorden, Norway, 3-4 Nov. 1970

Avail: NTIS

The experimental aeroelastic analysis of the T-tail configuration of the F-28 transport aircraft is discussed. The construction of the tail surfaces is described and the results of wind tunnel tests are presented. The influence of rudder-stabilizer interference effects on the T-tail flutter is emphasized. P.N.F.

N71-34003# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Aeronautical Engineering.

ON THE INDUCED DRAG OF THIN PLANE DELTA WINGS. AN EXPERIMENTAL STUDY OF THE SPANWISE DISTRIBUTION OF THE LEADING EDGE FORCES AT LOW SPEEDS

Sven-Olof Ridder May 1971 56 p refs

(KTH-Aero-TN-57) Avail: NTIS

The induced drag characteristics of three 60 degree delta wings of identical planform but with different leading edge radius spanwise distributions were investigated in a low speed wind tunnel. Of the wings tested the one with a constant leading edge radius along the edge gives the widest C sub L-range for low induced drag. The spanwise distribution of the local leading edge forces has been measured by means of a separate leading edge panel element mounted on a sensitive strain gauge balance. Author

N71-34004*# Cornell Aeronautical Lab., Inc., Buffalo, N.Y. A SECOND ORDER SLENDER WING THEORY FOR WINGS WITH LEADING EDGE SEPARATION IN SUPERSONIC FLOW

Joseph P. Nenni and Chee Tung Washington NASA Sep. 1971 65 p refs

(Contract NAS1-9543)

(NASA-CR-1860; AF-2883-S-1) Avail: NTIS CSCL 01A

A second order slender wing theory was developed for calculating the supersonic flow over low aspect ratio wings with subsonic leading edges and leading edge separation. The theory is second order in terms of the ratio of span to chord. The theory was developed by using a combined application of the method of strained coordinates and matched asymptotic expansions. The Brown and Michael flow model was used to model the leading edge separation. The theory is compared with experiment for delta wings and provides a substantial improvement over previous slender wing results but still overestimates normal force. The theory qualitatively predicts the correct Mach number trend and approaches the correct level for a sonic leading edge. The trend is somewhat overpredicted, however, producing best agreement at the higher Mach numbers. Author

N71-34005# National Aerospace Lab., Tokyo (Japan). DEVELOPMENT OF THE FA-200XS EXPERIMENTAL AIRPLANE

1970 30 p refs In JAPANESE; ENGLISH summary

(NAL-TR-229) Avail: NTIS

The FA-200XS is an experimental plane being developed to investigate the operational problems of STOL type airplane. The plane is generally similar to the original FA-200 (Aerobatic Category Certification) light airplane, but is equipped with full span slats and flaperons, as well as a boundary layer control system using distributed area suction located on the leading edges of flaps and ailerons. The experiments for the developments consisted of 2- and 3-dimensional wind tunnel tests, and several series of flight tests to investigate the aerodynamic characteristics of the FA-200X and FA-200XS. Author

N71-34006# Brussels Univ. (Belgium).

AERODYNAMIC PROPERTIES OF A FLEXIBLE BLADE GRID [PROPRIETES AERODYNAMIQUES D'UNE GRILLE D'AUBES FLEXIBLES]

Charles Hirsch 1969 160 p refs In FRENCH

(NT-21) Avail: NTIS

Theoretical and experimental determination of flexible wing profile deformation are presented. Calculations were made using variable flexible blade grids and changing Reynolds numbers. Graphs and charts are included. Results indicate theoretical and experimental calculations are in good agreement with each other. Transl. by E.H.W.

N71-34008*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

HYPERSONIC AERODYNAMIC CHARACTERISTICS OF A VARIABLE-DIHEDRAL DELTA-WING SPACECRAFT CONFIGURATION

James C. Ellison and Bernard Spencer, Jr. Washington Sep. 1971 21 p refs

(NASA-TM-X-2391; L-7752) Avail: NTIS CSCL 22B

An investigation of a variable-dihedral delta-wing spacecraft concept has been conducted in a hypersonic flow apparatus at a Mach number of 10.03. Angle of attack was varied from -5 deg to about 38 deg at angles of sideslip of 0 deg and -5 deg. Static longitudinal and lateral-directional characteristics were investigated for wing dihedral angles of 0 deg, 30 deg, 60 deg, 90 deg, and 110 deg for both 0 deg and 13 deg of wing toe-in. Author

N71-34009*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

ANALYTIC STUDIES OF SOUND PRESSURES INSIDE

THE DUCT OF DUCTED PROPELLERS

Joseph A. Drischler Washington Sep. 1971 40 p refs
(NASA-TN-D-6345; L-7378) Avail: NTIS CSCL 01A

The sound-pressure field of a rotating ducted propeller in forward flight is analyzed by replacing the duct by an infinite coaxial circular cylinder and assuming that the blade loading distribution associated with the thrust and the torque can be represented by a distribution of acoustic pressure doublets acting at the propeller disk. Trend studies are made to ascertain the effect on the pressure distribution inside the duct of variations in propeller loading, tip clearance, free-stream Mach number, tip Mach number, and hub-tip ratio. The effect on the pressure distribution of concentrating the loading at various radial positions on the propeller blade is also investigated. Author

N71-34012 Stanford Univ., Calif.

A TRAILING-EDGE CORRECTION FOR SUBSONIC SLENDER-WING THEORY

Robert Sugden Rogallo (Ph.D. Thesis) 1970 58 p
Avail: Univ. Microfilms Order No. 70-18463

Slender wing theory, the asymptotic lifting surface theory for small aspect ratio, is a singular perturbation problem and exhibits nonuniformities wherever its first-order chordwise loading is nonanalytic. The most useful example is the straight trailing edge, normal to the undisturbed free stream, located at the station of maximum span. The trailing edge nonuniformity is analyzed using the method of matched asymptotic expansions. Universal corrector potential problems are formulated but not solved. The dependence of the lift upon aspect ratio and planform geometry is given explicitly and the universal constants required are estimated by using Lawrence's theory of slender wings as a model of the full problem. Dissert. Abstr.

N71-34013*# United Aircraft Corp., East Hartford, Conn.

APPLICATION OF BORON/EPOXY REINFORCED ALUMINUM STRINGERS FOR THE CH-54B HELICOPTER TAIL CONE. PHASE 1: DESIGN, ANALYSIS, FABRICATION AND TEST Final Report, Feb. - May 1971

R. T. Welge Jul. 1971 126 p refs
(Contract NAS1-10459)

(NASA-CR-111929) Avail: NTIS CSCL 01C

A preprototype study is presented of the CH-54B tail cone in which component fabrication, testing, and analysis was done, and the strength adequacy of boron/epoxy reinforced members was verified. The vertical stiffness of the CH-54B tail cone was maintained with an approximate 70 per cent saving in stiffening weight by the application of boron/epoxy reinforced stringers. The boron/epoxy stringer reinforcement was configured such that the stiffness of the current production aluminum tail cone was achieved with minor changes. A boron/epoxy strip 0.750 x 0.250 inches was bonded to the vertical legs of the standard aluminum stringers. A joint analysis detailed the end taper of the boron/epoxy reinforcement necessary to reduce the peak shear stresses. Conventional and boron reinforced panels were fabricated and comparative shear and compression panel tests conducted. Test results indicated that the shear capability of the panels was unchanged by the presence of the boron, while the compression tests results showed the reinforced panels capable of withstanding higher loads. Of significance is the fact that an adequate bond and tapered boron/epoxy joint was achieved.

Author

N71-34014*# United Aircraft Corp., East Hartford, Conn.

CH-54B BORON/EPOXY REINFORCED TAIL CONE DETAILED STRUCTURAL SUBSTANTIATION Final Report

D. W. Lowry and S. Ciardullo Jul. 1971 381 p refs

(Contract NAS1-10459)

(NASA-CR-111930) Avail: NTIS HC \$6.00/MF \$0.95 CSCL 01C

A detailed structural analysis was made of the tail cone and transition section of the CH-54B helicopter reinforced with boron/epoxy stringers. A conservative analytical approach was used in that the analysis for the critical flight conditions included

the assumptions of no stringer reinforcement, and partial stringer reinforcement. Positive margins of safety were shown in all conditions. The boron/epoxy reinforced stringers necessitated minor tail cone modifications and the structural stiffness of the current CH-54B tail cone was maintained. Author

N71-34015*# National Aeronautics and Space Administration, Washington, D.C.

REPORT OF THE COMMITTEE FOR AIR TRANSPORT ON PLAN 6 [RAPPORT DU COMITE DES TRANSPORTS AERIENS SUR LE 6 PLAN]

Jean Cahen-Salvador Washington NASA Sep. 1971 91 p
Transl. into ENGLISH from French report
(NASA-TT-F-13947) Avail: NTIS CSCL 01B

The conclusions are summarized of studies which the French Committee for Air Transport conducted. The studies were aimed at defining proposals and recommended directions in the air transport field for the coming five years. The material is presented in three sections that deal with (1) options, goals, and general data; (2) resources and their programming; and (3) the financial envelopes. D.L.G.

N71-34016*# Kaman Avidyne, Burlington, Mass.

AUTOMATIC GUIDANCE FOR VTOL AIRCRAFT Final Report

William C. Hoffman Feb. 1970 170 p refs
(Contract NAS12-2097)

(NASA-CR-121768; TR-66) Avail: NTIS CSCL 01B

A simple perturbation feedback scheme is developed for automatic guidance of a VTOL aircraft with a velocity-command flight control system. By neglecting the delay required to attain a commanded velocity and by using ground range to touchdown rather than time as the independent variable, a reduced model having two state variables (altitude and crossrange) and three control variables, components of commanded velocity, was obtained. The model was linearized by taking first-order perturbations about a nominal trajectory. By minimizing a performance index which was quadratic in both the state and the control variables, an effective linear feedback guidance law was developed. The performance of the guidance concept was evaluated by means of a six-degree-of-freedom digital simulation of the YHC-1A tandem rotor helicopter with the NASA/ERC velocity-command flight control system. Simulation results indicated that the scheme can successfully handle a variety of off-nominal conditions, including initial condition errors, winds, and uncertainties in aircraft characteristics. Author

N71-34017*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

AIRFLOW CONTROL SYSTEM FOR SUPERSONIC INLETS Patent Application

Glenn A. Mitchell, inventor (to NASA) and Bobby W. Sanders, inventor (to NASA) Filed 11 Jun. 1971 10 p

(NASA-Case-LEW-11188-1; US-Patent-Appl-SN-152328) Avail: NTIS CSCL 01B

In addition to fixed and variable bleed devices provided for controlling the position of a terminal shock wave in a supersonic inlet, a plurality of free piston valves are disposed around the periphery of a cowl of a supersonic engine inlet. The free piston valves are disposed in dump passageways. Each valve begins at a bleed port in the cowl that is located in the throat region of the inlet where the diameter of the centerbody is near maximum and terminates at an opening in the cowl adjacent a free piston valve. Each valve is controlled by a reference pressure. NASA

N71-34018# Cranfield Inst. of Technology (England).

THE PREDICTION OF EMPTY WEIGHT RATIO AND CRUISE PERFORMANCE OF VERY LARGE SUBSONIC

JET TRANSPORT AIRCRAFT

D. Howe Jan. 1971 20 p refs
(Cranfield-Aero-3) Avail: NTIS

The empirical trend of the empty weight ratio of long range subsonic jet transports is analyzed in order to enable the cruise performance of very large aircraft to be predicted. Each of the main items which go to make up the empty weight is dealt with individually in order that the effect of size on each can be established. Consideration is given to the effect of increased wing loading on take off runway requirements. It is concluded that it would be feasible to produce an aircraft capable of carrying up to 1000 passengers over the great majority of all transatlantic routes. Such an aircraft would have an empty weight ratio of about 0.5 and would weigh approximately twice as much as the largest subsonic jet at present in existence.

Author

N71-34019# Loughborough Univ. of Technology (England). Dept. of Transport Technology.

A SOCIAL SURVEY INTO ANNOYANCE CAUSED BY THE INTERACTION OF AIRCRAFT NOISE AND TRAFFIC NOISE

C. G. Bottom and D. M. Waters [1971] 15 p refs
(TT-7102) Avail: NTIS

The procedure which was adopted to investigate the community response to combined noise from aircraft and road traffic is described. A social survey was conducted at nine sites at three levels of aircraft and traffic noise with thirty-five interviews per site. The mean results without regard to traffic noise level show good agreement with previous data, but there are significant variations with respect to traffic noise level. The use of the noise pollution level concept, which describes the noise climate as a function of mean energy level and the standard deviation of sound level, leads to strong correlation and median dissatisfaction with the total noise environment. Author

N71-34020 International Civil Aviation Organization, Montreal (Quebec).

AIRWORTHINESS COMMITTEE, NINTH MEETING

1971 112 p Meeting held at Montreal, 16 Nov. - 4 Dec. 1970

(DOC-8925; AIR-C-9) Copyright. Avail: Issuing Activity

Agenda items for the International Civil Aviation Organization's Ninth Meeting of the Airworthiness Committee included: review of progress on the development of acceptable means of compliance and provisional acceptable means of compliance; STOL and VTOL aircraft; airplane performance problems; provisions to enable aircraft to withstand bird strikes; crash survival; airworthiness aspects of Resolution A17-17 of the 17th Session of the Assembly; exchange of views items; preparation of a revised work program, work to be done, and assignment of tasks to members; and consideration of a need for a tenth meeting including, as necessary, proposals for a tentative agenda. Committee actions and recommendations on the agenda items are included. J.G.M.

N71-34021# Boeing Scientific Research Labs., Seattle, Wash. Aerodynamics and Marine Sciences Lab.

GLOBAL DISPERSION OF SUPERSONIC TRANSPORT EXHAUST IN THE STRATOSPHERE

C. Berman and A. Goldberg Jul. 1971 21 p refs
(D180-12981-1) Avail: NTIS

Calculations were made for the possible peak regional concentration of supersonic civil transport fleet exhaust emissions into the stratosphere. The heaviest traffic occurs in the Northern Hemisphere zone. Peak concentrations are reduced from those levels calculated for the assumption of an atmosphere with zero motion by moderating effects of zonal winds and interzonal turbulent diffusion. For a diffusion coefficient of 2×10 to the 9th power sq cm/sec, the regional peak value for the global dispersion of supersonic civil transport exhaust is a factor of 1.68 greater than a world average based on a uniform distribution. Author

N71-34022*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

THE INFLUENCE OF VERTICAL WIND GRADIENTS ON THE LONGITUDINAL MOTION OF AIRPLANES

Joseph Gera Washington Sep. 1971 19 p refs
(NASA-TN-D-6430; L-7671) Avail: NTIS CSCL 01B

An assessment of the influence of wind shear on the longitudinal motion of airplanes is presented. It was assumed that the wind is completely horizontal and its speed varies linearly with altitude. It is shown quantitatively that both glide and climb performance are influenced by wind shear and that trimmed flight at constant airspeed, attitude, and with fixed controls is along a parabolic path relative to the ground. The problem of the landing approach in a wind shear is examined in some detail. Small-disturbance theory indicates no wind-shear effect on the short-period motion and the time for the phugoid to damp to half amplitude but the phugoid frequency and damping ratio vary considerably with wind shear. A nondimensional quantity which depends on the wind shear and airspeed is shown to be a fundamental parameter influencing the longitudinal dynamic behavior of the airplane. Author

N71-34023# Defense Documentation Center, Alexandria, Va. **ENVIRONMENTAL POLLUTION: NOISE POLLUTION, SONIC BOOM, VOLUME 1** Bibliography Report, Apr. - Jul. 1970

Apr. 1971 86 p refs
(AD-722910; DDC-TAS-71-9-1) Avail: NTIS CSCL 20/1

The unclassified, annotated bibliography is Volume I of a two-volume set on Noise Pollution - Sonic Boom in a series of scheduled bibliographies on Environmental Pollution. Volume II is Confidential. Corporate author-monitoring agency, subject, title, contract, and report number indexes are included.

Author (GRA)

N71-34024# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.

AIRCRAFT GROUND FLOTATION ANALYSIS PROCEDURES: PAVED AIRFIELDS Technical Report, Jan. - May 1969

Dale E. Creech and Donald H. Gray Jan. 1971 56 p refs
Supersedes SEG-TR-67-52; N68-31777
(AD-720273; ASD-TR-70-43; SEG-TR-67-52) Avail: NTIS CSCL 01/2

The report describes standardized methods for analyzing ground flotation characteristics for aircraft of various designs based on the type of airfield construction. The methods described were applied in an analysis of the KC-135 aircraft to illustrate the techniques. These methods can be applied to any aircraft to determine its flotation characteristics in relation to a given type runway. Author (GRA)

N71-34025*# Litchford Systems, Northport, N.Y.

AERONAUTICS AND AIR TRAFFIC CONTROL

G. B. Litchford Washington NASA Aug. 1971 198 p
(Contract NASw-1849)
(NASA-CR-1833) Avail: NTIS CSCL 01B

A study and evaluation is made of the broad aspects of air traffic control and its relationship to the future of aeronautics. Present ATC techniques of controlling air traffic primarily by ground personnel are compared with new concepts wherein the pilot becomes a more active participant in the air traffic control process. Adequate progress in ATC cannot be expected until far better testing, validation, and design tools become available. Some candidates for new national facilities for testing various aspects of ATC and related aeronautics are identified. ATC technology in its broadest sense is essentially emerging as a new professional area. New programs and courses in ATC technologies are needed in curricula of colleges and universities to produce sufficient numbers of qualified graduates. Improved communications between the diverse disciplines impacting ATC progress is essential. Often a given government agency

represents but a few of the many disciplines involved. It is urged that an improvement in the application of the total government resources in ATC technology be made. The fractional elements within government, industry, and the universities required for the solution of ATC technology can be brought together and focused on a progressive national solution. Author

N71-34026*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HIGH-ALTITUDE FLIGHT TEST OF A REEFED 12.2-METER-DIAMETER DISK-GAP-BAND PARACHUTE WITH DEPLOYMENT AT A MACH NUMBER OF 2.58
 John S. Preisser and R. Bruce Grow Washington Sep. 1971 65 p refs Technical Film Supplement L-1106 available on request
 (NASA-TN-D-6469; L-7772) Avail: NTIS CSCL 01C

A reefed 12.2-meter nominal-diameter (40-ft) disk-gap-band parachute was flight tested as part of the NASA Supersonic High Altitude Parachute Experiment (SHAPE) program. A three-stage rocket was used to drive an instrumented test payload to an altitude of 43.6 km (143,000 ft) and a Mach number of 2.58 where the parachute was deployed by means of a mortar. After a time delay of about 8.5 seconds, the parachute was disreefed at a Mach number of 0.99. An analysis of parachute inflation, drag, and stability for both the reefed and unreefed parts of the test are reported. In addition, detailed descriptions of the test parachute, the reefing system, and the parachute packing procedure are included. Author

N71-34027*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE ELASTIC RESPONSE OF BIAS-PLY AIRCRAFT TIRES TO BRAKING FORCES
 John A. Tanner, John L. McCarty, and Sidney A. Batterson Washington Sep. 1971 31 p refs
 (NASA-TN-D-6426; L-6605) Avail: NTIS CSCL 01B

The elastic behavior of a braked rolling tire and relation of this behavior to the tire characteristics obtained from simple static flexure tests are discussed. The study consisted of static and braked-rolling tests of two types of bias-ply aircraft tires and an analysis which related tire reaction to the braking forces. The elastic response of an aircraft tire to braking forces can be defined by the displacement distribution along the tire periphery and by the fore-and-aft spring constant. Changes in the rolling radius due to braking can be predicted with reasonable accuracy from elastic measurements of the static free-tread periphery or from elastic measurements within the footprint during low-speed braking, assuming there is no slippage between the tire and the pavement. The results of these tests further indicate that what was heretofore considered as pure tire slippage under braked-rolling conditions may be wholly or in part the result of tire elasticity. The elasticity must be considered in the design or application of efficient automatic braking systems. Author

N71-34028*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
WIND-TUNNEL INVESTIGATION OF AN EXTERNAL-FLOW JET-FLAP TRANSPORT CONFIGURATION HAVING FULL-SPAN TRIPLE-SLOTTED FLAPS
 Lysle P. Parlett, H. Douglas Greer, Robert L. Henderson, and C. Robert Carter (Army Air Mobility R and D Lab.) Washington Aug. 1971 267 p refs
 (NASA-TN-D-6391; L-7730) Avail: NTIS CSCL 01A

A wind-tunnel investigation was conducted to determine the performance, static stability, and control characteristics of an external-flow jet-flap transport configuration having inboard pod-mounted engines and full-span triple-slotted flaps. Tests were made with the engines mounted clustered at 22.0 percent and 30.4 percent semispan to represent double (siamese) pods and with engines mounted at 22.0 percent and 41.7 percent semispan to represent a more spread arrangement. Tests were

also made to evaluate the effectiveness of wing leading-edge blowing as a means of improving the aerodynamic efficiency of the configuration and of eliminating the large engine-out roll asymmetries that occurred for the configuration when the wing with an engine-put stalled first. Author

N71-34029# National Transportation Safety Board. Washington, D.C.
AIRCRAFT ACCIDENT REPORT. ALITALIA AIRLINES MCDONNELL-DOUGLAS DC-8-62, 1-DIWZ (ITALIAN REGISTRY), JOHN F. KENNEDY INTERNATIONAL AIRPORT, JAMAICA, NEW YORK, 15 SEPTEMBER 1970
 28 Apr. 1971 25 p refs
 (NTSB-AAR-71-9) Avail: NTIS

Alitalia Airlines Flight 618, made a hard landing at approximately 1321 EDT, September 15, 1970. The accident occurred following a localizer approach to Runway 4R. The glide slope portion of the Instrument Landing System (ILS) was inoperative. There were no fatalities. The 10 crewmembers and 146 passengers evacuated the aircraft after it came to a stop in a sandy area to the west of Runway 4R. Sixty-nine occupants, 11 of whom were hospitalized, sustained injuries. The aircraft departed the left side of the runway and as it continued in a divergent path from the runway it ground-looped to the left before coming to a stop. The fuselage split open in an area just aft of the wing. Three of the engines separated from the aircraft during the landing rollout. The National Transportation Safety Board determined that the probable cause of this accident was the use of reverse thrust in flight, contrary to published procedures, with a resultant uncorrectable high sink rate. The captain's decision to use reverse thrust and not to execute a missed approach was a reaction under stress occasioned, at least in part, by air traffic control (ATC) instructions which led to positioning the aircraft too high and too close to the runway. ATC vectored the aircraft to the final approach path under IFR conditions and in the absence of an operating ILS glide slope. Author

N71-34030# National Transportation Safety Board. Washington, D.C.
AIRCRAFT ACCIDENT REPORT. TRANS INTERNATIONAL AIRLINES CORPORATION, FERRY FLIGHT 863, DOUGLAS DC-8-63F, N4863T, J. F. KENNEDY INTERNATIONAL AIRPORT, NEW YORK, 8 SEPTEMBER 1970
 18 Aug. 1971 35 p refs
 (NTSB-AAR-71-12) Avail: NTIS

The results of an investigation of the fatal crash of a DC-8 aircraft at Kennedy Airport, New York on September 8, 1970 are presented. The crash occurred shortly after takeoff due to loss of elevator control and eleven crew members were killed. Cause was determined to be a piece of asphalt from the eroded runway jamming the elevators. Analysis of records obtained from the flight data recorder and the voice recorder contributed to final decision regarding accident cause. P.N.F.

N71-34031# National Transportation Safety Board. Washington, D.C.
AIRCRAFT ACCIDENT REPORT. COMPANIA ECUATORIANA DE AVIACION DOUGLAS C-54D, REPUBLIC OF ECUADOR, HC-AON MIAMI INTERNATIONAL AIRPORT, MIAMI, FLORIDA, 14 APRIL 1970
 16 Dec. 1970 28 p
 (PB-199330; NTSB-AAR-71-2) Avail: NTIS CSCL 01B

A Douglas C-54D, HC-AON, of Ecuadorian registration, crashed at Miami International Airport, Miami, Florida, at approximately 0724 e.s.t., April 14, 1970. The aircraft was being operated as an international cargo flight by Compania Ecuatoriana de Aviacion. The accident occurred during the initial climb, following an instrument takeoff on Runway 27 right at Miami International Airport. The flight was en route from Miami to Panama City, Panama, the first leg of a flight which was to

terminate at Quito, Ecuador. The two pilots, the only occupants of the aircraft, were killed, and the aircraft was demolished by impact and postimpact ground fire. The board determines that the probable cause of this accident was improper monitoring of the flight instruments during a takeoff in instrument meteorological conditions. Additional pertinent factors were the use of improper procedures after takeoff and the reduced visibility due to fog.

Author (GRA)

N71-34032# Tri-State Transportation Commission, New York.
METROPOLITAN AIRCRAFT NOISE ABATEMENT POLICY STUDY, JOHN F. KENNEDY INTERNATIONAL AIRPORT, NEW YORK, NEW YORK

1970 126 p refs Sponsored in part by the Dept. of Housing and Urban Develop., Washington, D. C.
 (PB-199723) Avail: NTIS CSCL 01B

Alternative measures, and combinations of measures. To provide relief from aircraft noise in affected communities around John F. Kennedy International Airport are presented. Recommendations for reducing aircraft-noise problems are discussed.

Author (GRA)

N71-34033# Tri-State Transportation Commission, New York.
METROPOLITAN AIRCRAFT NOISE ABATEMENT POLICY STUDY, JOHN F. KENNEDY INTERNATIONAL AIRPORT, NEW YORK, NEW YORK. TECHNICAL SUPPLEMENT: CERTAIN LEGAL ASPECTS OF REQUIRED SOUNDPROOFING IN HIGH NOISE AREAS

Feb. 1971 133 p refs Prepared by Cleary, Gottlieb, Steen, and Hamilton, New York

(PB-199725; Rept-9613) Avail: NTIS CSCL 01B

With respect to airplane noise in the high noise areas next to John F. Kennedy International Airport, the report considers certain legal aspects of state and local compulsory soundproofing proposals with respect to new and existing structures. The study is made primarily in light of Federal and New York state constitutional provisions and certain state and local legislation.

Author (GRA)

N71-34170 North Carolina State Univ., Raleigh.
AN EVALUATION OF AIRCRAFT COLLISION-HAZARD WARNING RADAR TECHNIQUES IN THE TERMINAL AREA

Charles Leslie Britt, Jr. (Ph.D. Thesis) 1970 183 p
 Avail: Univ. Microfilms Order No. 70-18960

A computer simulation approach is used to determine the performance of various idealized collision-warning radar systems under actual flight conditions. A data base consisting of twelve hours of radar traffic data from the Atlanta, Ga., terminal was obtained in cooperation with the FAA and NASA, and is used to determine statistical data on the performance of the various systems. Probabilities of alarms, average alarm rates, and statistics on alarm durations are estimated for the systems considered. The results of the computer simulations indicate that the false alarm problem in the terminal area is much more severe than had been previously recognized. With simulated systems that have been proposed as providing sufficient warning times, excessive alarms would have occurred under the flight conditions represented by the data. The most promising systems investigated that appear applicable to both general and commercial aviation will provide a minimum warning time on the order of thirty seconds for a co-altitude treat under the flight constraints assumed.

Dissert. Abstr.

N71-34236*# McDonnell Aircraft Corp., St. Louis, Mo.
HYPERSONIC RESEARCH FACILITIES STUDY, VOLUME 2, PART 1: RESEARCH REQUIREMENTS AND GROUND FACILITY SYNTHESIS. PHASE 1: PRELIMINARY STUDIES

2 Oct. 1970 571 p
 (Contract NAS2-5458)

(NASA-CR-114323; MDC-A0013-Vol-2-Pt-1) Avail: NTIS CSCL 14B

A study was conducted to compare the characteristics of hypersonic research facilities considering research capability, versatility, adaptability, system confidence, and costs. The results of the research requirements analysis and the design and cost synthesis of the ground facilities are presented.

D.L.G.

N71-34237*# McDonnell Aircraft Corp., St. Louis, Mo.
HYPERSONIC RESEARCH FACILITIES STUDY, VOLUME 3, PART 1: RESEARCH REQUIREMENTS AND GROUND FACILITY SYNTHESIS. PHASE 2: PARAMETRIC STUDIES

2 Oct. 1970 397 p refs
 (Contract NAS2-5458)

(NASA-CR-114325; MDC-A0013-Vol-3-Pt-1) Avail: NTIS CSCL 14B

Based on the results of a previous study, which compared the characteristics of a broad group of flight research and ground research facilities, parametric studies were initiated to refine the facility designs and obtain sensitivity information in the neighborhood of near optimum designs, and to select those facilities that appear most attractive in the sense of research potential vs cost for further refinement. The results are presented of the research requirements analysis and the synthesis of the ground research facilities.

D.L.G.

N71-34238*# McDonnell Aircraft Corp., St. Louis, Mo.
HYPERSONIC RESEARCH FACILITIES STUDY, VOLUME 4, PART 2: GROUND RESEARCH FACILITIES. PHASE 3: FINAL STUDIES

2 Oct. 1970 346 p refs
 (Contract NAS2-5458)

(NASA-CR-114328; MDC-A0013-Vol-4-Pt-2) Avail: NTIS CSCL 14B

A previous study identified five facilities, out of eleven considered, as those which could provide the necessary technological increment at minimum costs. The present study involved refining the definition of the equipment and components associated with the five facilities to improve the base from which detailed cost estimates and development assessments were made. The results are presented of the analysis of the ground research facilities which refined the description of the more favorable concepts.

D.L.G.

N71-34239*# McDonnell Aircraft Corp., St. Louis, Mo.
HYPERSONIC RESEARCH FACILITIES STUDY, VOLUME 4, PART 3: RESEARCH REQUIREMENTS ANALYSIS AND FACILITY POTENTIAL. PHASE 3: FINAL STUDIES

2 Oct. 1970 211 p refs
 (Contract NAS2-5458)

(NASA-CR-114329; MDC-A0013-Vol-4-Pt-3) Avail: NTIS CSCL 14B

A series of studies was conducted to assess the research requirements for hypersonic aircraft and define several desirable hypersonic research facilities based on these requirements. The results of these studies are summarized and include: (1) definition of the major research tasks applicable to operational hypersonic systems, (2) design of two attractive flight research vehicles and five conceptual ground research facilities, and (3) a quantitative evaluation of individual facility capability to accomplish the identified research tasks.

D.L.G.

N71-34240*# Research Triangle Inst., Durham, N.C. Engineering and Environmental Sciences Div.
AN ANALYTICAL INVESTIGATION OF ACQUISITION TECHNIQUES AND SYSTEM INTEGRATION STUDIES FOR A RADAR AIRCRAFT GUIDANCE RESEARCH FACILITY, PHASE 2

W. S. Thompson Jul. 1971 109 p refs

(Contract NAS1-8912)

(NASA-CR-111931) Avail: NTIS CSCL 14B

User requirements and instrumentation plans are presented for upgrading an aircraft tracking and guidance facility. The present system tracking will be replaced with an FPS-16 radar supplemented by a laser tracker permanently mounted on the antenna. A real-time data handling system for receiving and processing digital tracking data and supply real-time outputs in digital or analog form is included. Investigations have determined that position accuracies of near touchdown + or - 1 ft and + or - 1/2 ft/sec in the vertical direction and + or - 2 ft and + or - 1 ft/sec in the horizontal directions can be achieved. E.M.C.

N71-34259# Vanderbilt Univ., Nashville, Tenn. Dept. of Mechanical Engineering.

A STUDY OF JET IMPINGEMENT ON CURVED SURFACES FOLLOWED BY OBLIQUE INTRODUCTION INTO A FREESTREAM FLOW Annual Report, 1 Feb. 1969 - 31 Jan. 1970

John W. Tatom, Norman M. Schnurr, John W. Williamson, and John H. Dunlap 15 Apr. 1971 117 p refs

(Grant NGR-43-002-034)

(NASA-CR-121736; AR-1) Avail: NTIS CSCL 20D

A study of the technology surrounding thrust reversers as particularly applied to Short Take Off and Landing (STOL) aircraft was initiated. The study is divided into two main subdivisions: (1) a study of jets introduced obliquely into a freestream flow, and (2) a study of jet impingement on curved surfaces. The former was further divided into an investigation of the flow field generated around a single engine nacelle by two hot, round opposing jets in the presence of a freestream, and an investigation of the hot, two-dimensional jet introduced at various angles into an opposing freestream. The results of the model nacelle testing suggest that pitching the reverse jet up asymmetrically is a useful technique for preventing engine exhaust ingestion and thereby increasing reverser utilization and performance. The study of jet impingement on curved surfaces was primarily an analytical effort. Experiments were performed for the purpose of verifying the assumptions on which the analysis is based. Satisfactory analytical and numerical solutions were obtained for a radial plane jet impinging on a cylindrical deflector and round radial jet impinging on a hemispherical surface. Author

N71-34274# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

MIXING OF HYDROGEN INJECTED FROM MULTIPLE INJECTORS NORMAL TO A SUPERSONIC AIRSTREAM

R. Clayton Rogers Washington Sep. 1971 35 p refs

(NASA-TN-D-6476; L-7896) Avail: NTIS CSCL 20D

The mixing of hydrogen downstream from a row of sonic injectors normal to a Mach 4 airstream was investigated to determine the effect of injector spacing. Injectors at spacings of 12.5 and 6.25 injector diameters were operated at ratios of jet dynamic pressure to free stream dynamic pressure between 0.5 and 1.5. Nominal free stream conditions were a stagnation temperature of 300 K and stagnation pressures of 1.38 and 2.07 MN/sq m. Turbulent boundary layer thickness at the injection station was 2.70 injector diameters. Measurements of hydrogen volume fraction and pitot and static pressures were made between 7 and 200 injector diameters downstream from the injectors. Results of the investigation indicated that the hydrogen penetration trajectory was not appreciably different from single injector results, being proportional to the 0.300 power of the dynamic pressure ratio. Maximum concentration decay with downstream distance for the wider injector spacing was correlated with the ratio of jet mass flux to free stream mass flux; for the closer spacing, the rate of decay of the maximum concentration was inversely proportional to the 0.286 power of the ratio of jet mass flux to free stream mass flux. Author

N71-34275# Boeing Co., Seattle, Wash. Aerospace Group.

THE NUMERICAL CALCULATION OF PLANE STEADY TRANSONIC FLOWS PAST LIFTING AIRFOILS

James A. Krupp (Ph.D. Thesis - Washington Univ.) Jun. 1971 129 p refs

(D180-12958-1) Avail: NTIS

Numerical solutions of the transonic potential equation for flow past lifting airfoils with free stream Mach number less than unity are presented. The work is based on the method of Murman and Cole. Modifications to the basic finite difference equations are discussed which yield improved resolution of weak shock and greater accuracy near the sonic line. The proper treatment of boundary conditions and the Kutta condition are discussed in detail. Extensive computations for four airfoils are presented and the results are compared with theory and experiment where applicable. Author

N71-34276# Lockheed Missiles and Space Co., Palo Alto, Calif. **UNSTEADY VISCOUS GAS FLOW BETWEEN TWO SOLID WALLS, ONE OF WHICH IS FREE AND VIBRATES AT HIGH FREQUENCY**

V. A. Bushkin et al 1971 6 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza (USSR), no. 2, 1971 p 111-116

Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The general equation of the pressure distribution in a thin viscous gas layer between two solid walls of arbitrary shape was developed. To investigate the quasistationary process in the gas layer, the free solid wall was allowed to vibrate at high frequency with no low frequency vibrations. The unsteady gas layer motion was investigated by allowing motion to occur in addition to the free wall vibrations. The plane gas motion between walls was then considered with an arbitrary perturbation superposed on the high frequency vibration of the freely vibrating wall. Finally, the stability of the free solid wall was considered. J.G.M.

N71-34592# Federal Aviation Administration, Washington, D.C. Flight Information Div.

IFR OFF-AIRWAY NON-95 ROUTES

May 1971 24 p

Avail: NTIS

A compilation of commercial and military instrument flying rules off-airway routes in the United States, Alaska, Puerto Rico, and Pacific Areas is presented. Each entry contains information required for safe instrument flight along the air route. P.N.F.

N71-34648# Martin Marietta Corp., Denver, Colo.

EVALUATION OF LIQUID METHANE STORAGE AND TRANSFER PROBLEMS IN SUPERSONIC AIRCRAFT Final Report

J. L. McGrew, D. L. Buskirk, H. F. Brady, and M. L. Leeds 6 Aug. 1971 264 p

(Contract NAS3-12411)

(NASA-CR-72952) Avail: NTIS CSCL 20L

The problems involved in using liquid methane in a supersonic cruise type aircraft were investigated. The analyses included pressurization and fuel transfer in systems using liquid methane in a saturated state, in the subcooled state, or partly as a saturated liquid and partly as a subcooled liquid. The program included designing and fabricating a test rig, conducting 49 tests, and reducing and analyzing some 100 channels of data. Three separate low-pressure tank configurations and one high-pressure tank were tested. The tests demonstrated that subcooled methane can be loaded and held for reasonable lengths of time under simulated aircraft conditions using methane vapors to maintain the pressurization. Author

N71-34944# General Motors Corp., Indianapolis, Ind. Detroit Diesel Allison Div.

EXPERIMENTAL EVALUATION OF LOW CYCLE THERMAL FATIGUE IN A TURBINE VANE FABRICATED FROM LAMINATED POROUS MATERIAL Final Report

D. A. Nealy, R. D. Anderson, and A. A. Hufford 15 Mar. 1971 116 p refs

(Contract NAS3-12431)

(NASA-CR-72954; DDAD-EDR-7034) Avail: NTIS CSCL 21E

The results of an experimental evaluation of low cycle thermal fatigue in laminated porous wall turbine vanes are presented. Details of the laminated porous wall vane design are given together with a description of the cascade test facility and associated instrumentation. Three test vanes were exposed to rapid cyclic gas temperature variations over a range from 1150 F to 2800 F. After 110 cycles of operation, transverse (chordwise) cracks were observed in the leading edge region of all three test vanes. Subsequent metallographic and structural analyses indicated the primary failure mechanism to be low cycle thermal fatigue. Agreement between predicted and observed fatigue life was very good. Author

N71-34945* Curtiss-Wright Corp., Wood-Ridge, N.J.

TIP-TURBINE LIFT PACKAGE DESIGN

R. Jaklitsch, A. Leto, W. Pratt, and R. Schaefer Jul. 1971 222 p

(Contracts NAS3-14327; NAS3-12423)

(NASA-CR-72974; CW-WR-71-034.F) Avail: NTIS CSCL 21E

A layout design of a lift fan driven by a two-stage hot turbine at the fan blade tips is reported. Layout drawings, a description of the lift package system, and a discussion of the design analyses are presented. Areas of major design analyses included segmented and continuous turbine blade support rings, a hot-gas scroll, hot-gas seals during transient thermal and maneuver load conditions, main support bearings, and system weight. Author

N71-35126* Clemson Univ., S.C. Mechanical Engineering Dept.

OPTIMIZATION OF STRUCTURES TO SATISFY AEROELASTIC REQUIREMENTS Final Report

Carl S. Rudisill 31 May 1971 19 p refs

(Grant NGR-41-001-027)

(NASA-CR-111955) Avail: NTIS CSCL 20K

Equations for finding the derivatives of the flutter velocity of an aircraft with respect to structural parameters were derived. A numerical procedure was developed for determining the values of the structural parameters such that a specified flutter velocity constraint is satisfied and the structural mass is a relative minimum. A search procedure was developed which utilized two gradient search methods and a projected gradient method. The procedure was applied to the design of a cantilevered box beam. A method for the optimization of a complex structure to satisfy a divergence velocity constraint has been developed and tested on a cantilevered box beam. This method is very similar to the method of optimization for a flutter velocity. Author

N71-35134* Aeronautical Research Labs., Melbourne (Australia).

CONSIDERATIONS RELEVANT TO THE VIBRATION TESTING OF AERONAUTICAL STRUCTURES HAVING NONIDEAL CHARACTERISTICS

M. G. Chandivert Dec. 1970 25 p refs

(ARL/SM-355) Avail: NTIS

The nonlinear features of the response of aeronautical structures to dynamic excitation forces are presented. In order to make the description of the structures more realistic, possible additions to the usual linear terms in the dynamical equations are considered. Possible consequences of a limited generalization of the linear framework usually assumed are reviewed with reference to the concept of mode and influence of initial conditions. Author

N71-35196* Cornell Aeronautical Lab., Inc., Buffalo, N.Y.

EXPERIMENTAL INVESTIGATION OF LEADING-EDGE SHOCK IMPINGEMENT AND INTERACTION HEATING ON A 1/80 SCALE MODEL OF A NASA STRAIGHT WING

ORBITER CONFIGURATION AT MACH NUMBERS 8 AND 16

C. E. Rogers Aug. 1971 128 p refs

(Contract NAS9-11084)

(NASA-CR-115159; CAL-AA-2977-Y-1) Avail: NTIS CSCL 20D

The leading-edge shock impingement and interaction heating on a 1/80 scale model of a NASA straight-wing orbiter configuration were investigated. The tests were conducted in the 96-inch Hypersonic Shock Tunnel at Mach number 8 (nominal) at Reynolds numbers of 2 million through 10 million per foot and at Mach number 16 at Reynolds numbers of .1 million and 1 million per foot. Model angle of attack was varied from 0 to 70 degrees and model sideslip angle was varied from 0 to 3 degrees. Measurements of chordwise local heat-transfer rates were made at five locations on the wing from the leading edge to 20 percent of the chord length. Sensors were placed to measure the steep gradients occurring in regions where the fuselage bow shock intersected the wing, where interactions from the fuselage were expected and in nondisturbed regions. In addition, measurements of spanwise local heat-transfer rates were made along the 17% chord line to help define the location and magnitude of the impingement and interaction heating. Schlieren photographs were also obtained to help define the flow field. The details of the test program and a description of the model, instrumentation and shock tunnel are presented. The results are presented in tabular and graphical form along with a brief discussion. Author

N71-35197* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

COMPARISONS OF THEORETICAL AND EXPERIMENTAL PRESSURE DISTRIBUTIONS OVER A WING-BODY MODEL AT HIGH SUPERSONIC SPEEDS

Lloyd S. Jernell Washington Sep. 1971 83 p refs

(NASA-TN-D-6480; L-7881) Avail: NTIS CSCL 20D

An investigation was conducted to determine the effectiveness of various theoretical methods in predicting the pressure distribution over a wing-body configuration at high supersonic speeds. Theoretical pressure coefficients are compared with experimental values obtained on delta planform wing-body model at Mach numbers from 2.30 to 4.63 and angles of attack to approximately 11 deg. Author

N71-35198* Advisory Group for Aerospace Research and Development, Paris (France). Structures and Materials Panel.

A COMPARISON OF METHODS USED IN LIFTING SURFACE THEORY

D. L. Woodcock (RAE, Farnborough, Engl.) Jun. 1971 149 p refs Supplement to the Manual on Aeroelasticity, Part 6; see N65-24758

(AGARD-R-583-71) Avail: NTIS

A joint research project organized by the AGARD Structures and Materials Panel is reported. The purpose of the project is to establish the relative merits of different methods of calculating the air forces on oscillating wings, and to provide a standard which can be used in the future for comparison or test purposes. A scheme of cases to be considered was set up which covered variations of the parameters: planform geometry, mach number reduced frequency and mode of oscillation. Contributions came from six countries using nearly thirty different methods and comprising nearly eight hundred calculations. The tabulated results are preceded by descriptions of the various methods used and by a comprehensive system of annotation. Author

N71-35201* Polytechnic Inst. of Brooklyn, Farmingdale, N.Y. Dept. of Aerospace Engineering and Applied Mechanics.

WISCOUS FLOW ALONG A CORNER. PART 3. EFFECTS OF AXIAL PRESSURE GRADIENT

Bernard Grossman and Stanley G. Rubin Feb. 1971 70 p refs (Grant AF-AFOSR-1843-70)

(AD-726546; PIBAL-71-4; AFOSR-71-0074TR) Avail: NTIS CSCL 20/4

The laminar, incompressible flow along a corner formed by the intersection of two thin airfoils is considered. The effects of small axial pressure gradients on the flow in the vicinity of the corner are determined as a perturbation to the flow along a corner formed by intersecting flat plates. The method of matched asymptotic expansions is used to determine the cross-flow induced second-order boundary-layer flow away from the corner, and these results serve as the asymptotic boundary conditions for the corner-layer analysis. The effects of both favorable and adverse pressure gradients on the cross flow are discussed. The corner-layer equations are solved numerically with a relaxation procedure. The results for the corners formed by intersecting thin wedges and intersecting Joukowski airfoils indicate that there are substantial interference effects even for very thin airfoil shapes, i.e., small axial pressure gradients. Author (GRA)

N71-35202# West Virginia Univ., Morgantown. Dept. of Aerospace Engineering.

ANALYSIS OF A CIRCULATION CONTROLLED ELLIPTICAL AIRFOIL

Jack P. Ambrosiani and Nathan Ness Apr. 1971 186 p refs (Contract N00014-68-A-0512; Proj. Themis) (AD-726434; TR-30) Avail: NTIS CSCL 20/4

The effect of trailing edge blowing on the circulation around an airfoil section is considered theoretically. The analysis is self-contained in that specification of the ambient conditions, flight conditions, and blowing conditions gives the sectional lift and drag coefficients on the prescribed airfoil section. The method of solution is an iterative one, and involves the matching of an assumed sectional lift coefficient with the sectional lift coefficient calculated from the actual pressure distribution over the body in the presence of trailing edge blowing. In order to obtain the pressure on the wall in the wall jet region a full boundary layer analysis is required over the airfoil. The Kármán-Pohlhausen integral method is used in the laminar region and the Nash and Hicks turbulent layer analysis is used in the turbulent region. Using the boundary layer properties on the upstream side of the wall jet, along with conservation of mass and momentum relations through the mixing zone, a new wall jet profile is found at the downstream end of the potential core. The wall jet region is then analyzed using integral methods including entrainment. The analysis represents an extension to the calculation method proposed by Kind, and reconfirms the feasibility of obtaining high lift coefficients with relatively low blowing rates. Author (GRA)

N71-35203 New York Univ., N.Y.

DIFFRACTION OF SHOCK WAVE BY A THIN WING: SYMMETRIC AND ANTISYMMETRIC PROBLEMS

Max Gunzburger (Ph.D. Thesis) 1969 122 p
Avail: Univ. Microfilms Order No. 70-19282

An analytical solution is obtained for the pressure distribution throughout the flow field due to the diffraction of a plane shock wave of arbitrary strength by a thin lifting or nonlifting wing moving in the opposite direction. For symmetric wings, the thickness is represented by a source distribution, while an antisymmetric wing is represented by a vortex distribution. The shock condition is fulfilled by extending the solution behind the shock into the region ahead of the shock and then finding the proper image behind the shock. For symmetric wings, the intensity of the source distribution is directly related to the thickness of the wing. For antisymmetric wings, the intensity of the vortex distribution is related to the inclination of the wing surface by an integral equation which can be reduced for each instant in time to an equivalent integral equation for a three dimensional steady flow. For a two dimensional plate at angle of attack an explicit solution for the pressure is obtained for a special combination of shock strength and wing speed.

Dissert. Abstr.

N71-35204# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

AERODYNAMICS OF LIFT FAN V/STOL AIRCRAFT

Jerry V. Kirk, Leo P. Hall, and Brent K. Hodder Sep. 1971 8 p refs Prepared in cooperation with Army Mobility Equipment Res. and Develop. Center (NASA-TM-X-62086) Avail: NTIS CSCL 01B

Lift fans have been shown to be effective for providing direct lift for V/STOL aircraft. The aerodynamic characteristics of podded lift fans located for and aft of the wing to allow higher wing loading and reduce constraints on wing design are discussed. The more important results are summarized, and the induced aerodynamic effects of various pod locations are shown. Because efficient use of the propulsion system may dictate that the fans also be used for high-speed cruise, the effectiveness of various methods for vectoring the fan flow from the cruise to the lift direction for low-speed transition is presented. An investigation was made for the aerodynamic characteristics of a 1.3 pressure ratio lift fan. Noise constraints were not placed on the design and construction of the fan, but subsequent modifications were incorporated to alleviate noise. Measurements of sound are given for the modified and the original fan operating in crossflow. Author

N71-35205# Goodyear Aerospace Corp., Akron, Ohio.
DESIGN, FABRICATION, AND STATIC TESTING OF FIRST-STAGE ATTACHED INFLATABLE DECELERATOR (AID) MODELS

B. A. Johnson 15 Sep. 1971 106 p refs (Contract NAS1-10105)

(NASA-CR-111934; GER-15267) Avail: NTIS CSCL 01C

Wind tunnel models of AID canopies were attached directly to a payload in a method which simulated a first-stage AID. All models had 140-deg conical aeroshells as their forebodies, and each model had four spring-actuated forward inlets mounted on the internal hard structure to provide for initial deployment. Full inflation and final pressurization was accomplished by four aft canopy inlets on each model. An inflation test was conducted in an environmental chamber to investigate packaging, deployment, and inflation characteristics of the models prior to wind tunnel testing. Author

N71-35206# Hamilton Standard Div., United Aircraft Corp., Windsor Locks, Conn.

ADVANCED GENERAL AVIATION PROPELLER STUDY

Rose Worobel and Millard G. Mayo Apr. 1971 211 p refs (Contract NAS2-5885)

(NASA-CR-114289) Avail: NTIS CSCL 01B

Methods for predicting the performance, noise, weight, and cost of propellers for advanced general aviation aircraft of the 1980 time period were developed and computerized. A propeller sensitivity study based on the computer program is presented for five representative general aviation aircraft. Conceptual design studies are included for three propellers selected from the sensitivity studies to check the weight and cost estimating procedures. Problem areas exist in the methodology defined and follow-on studies are recommended. A listing of the computer program is presented. Author

N71-35207# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

PRELIMINARY STUDY OF AN AIR GENERATOR-REMOTE LIFT FAN PROPULSION SYSTEM FOR VTOL TRANSPORTS

James F. Dugan, Jr., Richard P. Krebs, Kestutis C. Civinskas, and Robert C. Evans Aug. 1971 24 p refs

(NASA-TM-X-67916; E-6543) Avail: NTIS CSCL 01B

A simplified mission analysis was performed to evaluate the effects of tip-turbine pressure ratio and lift-fan pressure ratio on payload and noise of a VSTOL airplane. The propulsion system consisted of four 15,000 pound thrust lift fans, eight 7500 pound thrust lift fans, and four air generators which were also used as the cruise engines. A range of 500 statute miles with two takeoffs and landings was selected along with a cruise

Mach number of 0.75 at an initial cruise altitude of 25,000 feet. The allowable gross weight was calculated to be 88,700 pounds. Cruise L/D was varied parametrically from 8 to 12 to determine its impact on the propulsion system and payload. Cruise performance calculations showed that the four air generators used as cruise engines provided reasonable cruise performance. A tip-turbine pressure ratio of 4 and a lift fan pressure ratio of 1.15 gave a near maximum payload of 12,600 pounds (62 passengers). From these preliminary results, it is concluded that the remote air generator lift fan propulsion system is a promising VSTOL transport propulsion system. Author

N71-35208*# Dow Chemical Co., Midland, Mich.
**DEVELOPMENT AND PRODUCTION OF HIGH-ALTITUDE
 DECELERATOR, LIGHTWEIGHT LOW PERMEABILITY
 BRACE MATERIAL** Final Report
 1971 32 p

(Contract NAS1-10347)
 (NASA-CR-111964) Avail: NTIS CSCL 01C

The selection of adhesive and coating formulations and the development of manufacturing sequences and conditions for lightweight low-permeability brace materials for use in high-altitude decelerators are reported. Permeability and physical property data are presented along with formulas and process conditions for Mylar metallizing and Saran coating materials.

J.M.

N71-35209*# National Aeronautics and Space Administration.
 Ames Research Center, Moffett Field, Calif.
**A FLIGHT EVALUATION OF A VTOL JET TRANSPORT
 UNDER VISUAL AND SIMULATED INSTRUMENT
 CONDITIONS**

Curt A. Holzhauser, Samuel A. Morello, Robert C. Innis, and James M. Patton Aug. 1971 125 p refs
 (NASA-TM-X-62083) Avail: NTIS CSCL 01B

A flight investigation was performed with the Dornier DO 31 VTOL transport to evaluate the performance, handling, and operating characteristics that are considered to be important when operating a commercial VTOL transport in the terminal area. The tests concentrated on the transition, approach, and vertical landing. The mixed jet-propulsion system provided a large usable performance envelope that enabled simulated IFR approaches to be made on 7 deg and 12 deg glideslopes. In these approaches management of thrust magnitude and direction was a primary problem, and some form of integrating the controls will be necessary. The handling qualities evaluation pointed out the need for additional research to define flight-path criteria. The aircraft had satisfactory control and stability in hover out of ground effect. The recirculation effects in a vertical landing were large below 15 meters. Author

N71-35210*# Lockheed-Georgia Co., Marietta. Advanced Concepts Dept.

**TECHNOLOGY ASSESSMENT OF ADVANCED GENERAL
 AVIATION AIRCRAFT** Final Report

C. H. Murkamp, W. M. Johnston, and J. H. Wilson Jun. 1971 376 p refs

(Contract NAS2-5972)
 (NASA-CR-114339) Avail: NTIS HC \$6.00/MF \$0.95 CSCL 01B

The potential impact of advanced technology in 1985 on four classes of general aviation aircraft were studied to recommend areas where further research and development will help to realize the potential improvements. The four categories include conventional, STOL and V/STOL performance in 4 to 9 place aircraft, with helicopters included in the study. The requirements for each category are listed. The study procedure of: (1) establishing an optimized design configuration in each category, based on present technology; (2) investigating and pinpointing the most promising areas of applicable technology; (3) applying the selected advanced technology to each of the present technology designs; and (4) assessing the results and making recommendations. The areas of advanced technology

include those of aerodynamics, propulsion, structural materials, avionics, flight safety, automatic control, noise, and emission abatement. These are assessed individually and in combination by means of a computerized analysis. The recommended combinations were then studied to determine their potential impact on the overall transportation system, after which, the areas of technical support are recommended. Author

N71-35211# Naval Air Engineering Center, Philadelphia, Pa. Engineering Dept.

**INVESTIGATIONS AND TEST OF WIRE ROPE CORE
 MATERIALS FOR AIRCRAFT ARRESTING ENGINE
 PURCHASE CABLE**

Cosimo D. Daiello and William Clark 21 May 1971 84 p refs
 (AD-724284; NAEC-ENG-7461) Avail: NTIS CSCL 13/9

An investigation and test of cores used in purchase cable for aircraft arrestment gear is made to determine if there is a core material superior to that presently used. Consultations with representatives of the wire rope industry and acknowledged authorities in the field of fiber testing, research and development are conducted. Wire rope core materials are selected and tested. Recommendations are made, with requirements for further testing, of possible superior substitutes. Author

N71-35212# Aircraft Research Association, Ltd., Bedford (England).

EXPERIENCE AT ARA ON FREE DROPPING STORES

R. H. Landon Aug. 1971 17 p refs
 (Rept-23) Avail: NTIS

The manufacture and testing of dynamically scaled store models for release in transonic wind tunnels is described. Considered in brief detail are some methods adopted in making both light and heavy models in fiberglass using simply constructed dies, and high speed recording techniques. Author

N71-35213*# National Aeronautics and Space Administration.
 Langley Research Center, Langley Station, Va.

**DYNAMIC STABILITY DERIVATIVES OF A JET TRANS-
 PORT CONFIGURATION WITH HIGH THRUST-WEIGHT
 RATIO AND AN EXTERNALLY BLOWN JET FLAP**

Sue B. Grafton, Lysle P. Parlett, and Charles C. Smith, Jr. Washington Sep. 1971 82 p refs
 (NASA-TN-D-6440; L-7870) Avail: NTIS CSCL 01B

The investigation was conducted to determine the dynamic stability derivatives of an externally blown jet-flap transport configuration having clustered inboard pod-mounted engines and full-span triple-slotted flaps. The results showed that the model had positive damping in pitch, roll, and yaw up to the stall angle of attack. The application of power resulted in an increase in pitch damping at high angles of attack and a moderate increase in yaw damping for the higher flap deflections but had no consistent effects on roll damping. For a given level of total engine thrust, the damping derivatives were generally not affected by frequency or by having one engine inoperative. Author

N71-35214# Southampton Univ. (England). Inst. of Sound and Vibration Research.

**THE LOUDNESS OF SONIC BOOMS HEARD OUTDOORS
 AS SIMPLE FUNCTIONS OF OVERPRESSURE AND RISE
 TIME**

D. N. May Apr. 1971 34 p refs Sponsored by Min. of Aviation Supply
 (ISVR-TR-46) Avail: NTIS

Semiempirical formulae which represent the loudness of sonic booms heard outdoors as functions of their peak overpressures and rise times only, were found to agree well theoretically with the accepted, more complex loudness calculations of Zepler and Harel, and Johnson and Robinson.

Moreover, in an experimental assessment using 34 sonic booms and up to 14 subjects, the semiempirical relations correlated with judged loudness at least as well as did the more complex ones. The use of the semiempirical formulae was recommended by virtue of their simplicity. Author (ESRO)

N71-35215# Royal Aircraft Establishment, Farnborough (England).

A NOTE ON THE T-TAIL FLUTTER

K. Washizu et al Apr. 1971 21 p refs Transl. into ENGLISH from J. Aerospace Soc. (Japan), v. 18 1970 p 327-333 (RAE-Lib-Trans-1548) Avail: NTIS

An analysis of T-tail flutter due to dihedral effect of the horizontal tail is presented. The flutter speed is found to be dependent on the angle of attack of the horizontal tail surface. Flutter characteristics of a simplified T-tail are described. Quasi-steady aerodynamic forces are used to represent the dihedral effect of the horizontal tail. Author

N71-35216# Rowland and Co., Haddonfield, N.J.
FUNCTIONAL ANALYSIS OF PILOT WARNING INSTRUMENT CHARACTERISTICS Final Report
George E. Rowland and Carl T. Reichwein Sep. 1971 86 p refs
(Contract DOT-FA69NA-357)

(FAA-RD-71-59; FAA-NA-71-40) Avail: NTIS

The functional analysis of pilot warning instrument systems presented is intended to disclose the role of the pilot in such systems and to describe the intricate relationships between the pilot, the PWI, and the operational aeronautical environment. Thirteen general functions are defined and illustrated; five performed by the PWI and eight by the pilot. The PWI functions are exemplified by references to hardware systems in use; the pilot functions are described through the use of mathematical models and empirical data. The general functions of PWI systems are structured into three categories of pilot-PWI systems. The major independent characteristics of these systems are then used to form system generation matrices. It is shown that over 70,000 different systems can be formed from these matrices. Recognizing the impossibility of dealing with such a number of potential PWI systems, an optimization technique and computer simulation layout are described that could be used in the selection of a limited set of optimal PWI characteristics.

Author

N71-35217*# Lockheed-Georgia Co., Marietta. Advanced Concepts Dept.

TECHNOLOGY ASSESSMENT OF ADVANCED GENERAL AVIATION AIRCRAFT Summary Report

C. H. Hunkamp, W. M. Johnston, and J. H. Wilson 1971 57 p refs

(Contract NAS2-5972)

(NASA-CR-114338) Avail: NTIS CSCL 01B

The impact of advanced technology applicable to general aviation aircraft for the 1985 time frame is assessed. The influence of advanced technology and new design philosophies on the cost, performance, and operational capabilities of general aviation aircraft is summarized. The four categories include conventional, STOL and V/STOL performance in 4 to 9 place aircraft, and helicopters. The areas of advanced technology include those of aerodynamics, propulsion, structural materials, avionics, flight safety, automatic control, and noise and emission abatement. These were assessed individually and in combination by means of a computerized analysis. The recommended combinations were then studied to determine their potential impact on the overall transportation system, after which the areas of technical support were recommended. Author

N71-35218# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.

AIRBORNE DISSEMINATION DEVICES Final Report

5 Mar. 1971 27 p refs

(AD-726350; MTP-8-3-080) Avail: NTIS CSCL 15/2

Procedures are prescribed for evaluating the functional suitability and compatibility of airborne dissemination devices.

Author (GRA)

N71-35219# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PRINCIPLES OF DESIGN OF VERTICAL TAKEOFF AND LANDING AIRCRAFT

F. P. Kurochkin 19 Feb. 1971 456 p refs Transl. into ENGLISH of the book "Osnovy Proektirovaniya Samoletov s Vertikalnym Vzletom i Posadkov" Moscow, Izd-vo Mashinostroyeniya, 1970 p 1-352

(AD-726572; FTD-MT-24-255-70) Avail: NTIS CSCL 01/3

The book is dedicated to the draft designing of a comparatively new type of aircraft possessing the takeoff and landing properties of helicopters and other flight characteristics peculiar to aircraft. The characteristics of their aerodynamic configurations basic parameters, gravimetric characteristics, and designs with various power plant compositions are examined. Turboprop (TP) and turbojet engines (TJ) (ordinary and special) were used in the composition of the latter both as sustainer and hoisting, and as composite engines accomplishing in one unit the role of the first and the second. Methods are given for calculating the specific vertical takeoff and landing aircraft (VTOL) processes of flight, for example the transfer from vertical flight to horizontal flight and conversely.

Author (GRA)

N71-35220# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DESIGN OF STRUCTURAL ELEMENTS OF AIRPLANES AND HELICOPTERS. TEXTBOOK FOR THE PLANNING OF COURSE AND GRADUATE WORK

V. N. Dalin 5 Feb. 1971 129 p refs Transl. into ENGLISH of the book "Proektirovaniye Elementov Konstruktsii Samoletov i Vertoletov. Posobie po Kursovomu i Diplomnomu Proektirovaniyu" Moscow, Gosudarstvennoye Nauchno-Tekhnicheskoye Izdatelstvo Oborongiz, 1962 p 1-78

(AD-726586; FTD-MT-24-247-70) Avail: NTIS CSCL 01/3

The book is a reference text on the design of aviation structural elements. It discusses criteria for the selection of materials for the designing of airplanes and helicopters. Techniques for increasing the strength of the materials and for their connection into units and assemblies are discussed against a background of assuring minimum weight and cost.

Author (GRA)

N71-35221# Honeywell, Inc., St. Paul, Minn. Research Dept.
A DESIGN PROCEDURE AND HANDLING-QUALITY CRITERIA FOR LATERAL-DIRECTIONAL FLIGHT CONTROL SYSTEMS Final Report, 17 Oct. 1969 - 17 Oct. 1970

Gunter Stein and Allen H. Henke May 1971 276 p refs

(Contract F33615-70-C-1190)

(AD-726584; Rept-12212-FR; AFFDL-TR-70-152) Avail: NTIS CSCL 01/3

The program develops a practical design procedure for aircraft augmentation systems based on quadratic optimal control technology and handling-quality-oriented cost functionals. The procedure is applied to the design of a lateral-directional control system for the F4C aircraft. The design criteria, design procedure, and final control system are validated with a program of formal pilot evaluation experiments. These use 5 x 2 x 3 mixed-design analysis of variance. A reformulated optimal model-following control problem is used as the cornerstone for the procedure. Design criteria are expressed as model differential equations satisfying available handling-quality data. The reformulation includes optimality over multiple flight conditions and constant gain and measurement realizability

constraints. A computational algorithm is developed to solve the new optimization problem. The algorithm successfully handled 20th-order F4C lateral-axes dynamics and optimized five flight conditions simultaneously. The results of the validation experiments were fully positive with strong correlation between performance and pilot opinion data. Author (GRA)

N71-35222# School of Aerospace Medicine, Brooks AFB, Tex. **MEDICO-LEGAL EXAMINATION OF AIRPLANE REMNANTS: ITS ROLE IN CAUSAL EVIDENCE [ZNACHENIYE SUDEBNO-MEDITSINSKOY EXPERTIZY OBLOMKOV SAMOLETA PRI RASSLEDOVANIYE AVIAKATASTROFY]** A. A. Lukash 1971 4 p Transl. into ENGLISH from Sudebno-med. Ekspertiza, Min, Zdravookhr. SSSR (Moscow), v. 11, no. 15, 1968 15 p (AD-726559; SAM-TT-R-1092-0771) Avail: NTIS CSCL 01/2

A medico-legal examination was undertaken to determine the possible cause of a jet aircraft crash. The remnants of the aircraft and the pilot's body were examined. The results indicated the crash was caused by collision with a bird. The collision caused the hermetic seal of the cabin and the aerodynamic characteristics of the aircraft to be destroyed, resulting in loss of control by the pilot. The examination also revealed that the pilot received head injuries from slivers of glass on impact. E.H.W.

N71-35223# Ohio State Univ. Research Foundation, Columbus. **AIR CUSHION PRESSURE DURING STIFF OPERATION FOR AIR CUSHION LANDING SYSTEM. PART 1: THEORY** Technical Report, Jul. 1969 - Jun. 1970 Lit S. Han Wright-Patterson AFB, Ohio AFFDL May 1971 79 p refs (Contract F33615-69-C-1001) (AD-726606; AFFDL-TR-71-4-Pt-1) Avail: NTIS CSCL 01/3

The report studies the performance characteristics of the air cushioned landing and takeoff system for aircraft during its stiff-operation mode. Stiff-operation is obtained during the early stage of the takeoff period or the later stage of landing. Its chief feature is that the pneumatic supply chamber of bleed air is in almost parallel configuration with the ground. The supply air flows vertically down through the bleed holes and is then deflected outward. This part of the report contains the theoretical treatment of the problem. The results are in the form of a cushion pressure ratio in terms of the supply (trunk) pressure. Analysis was performed, based on incompressible viscous theory. Author (GRA)

N71-35224# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div. **PRACTICAL AERODYNAMICS AND AIRCRAFT** G. V. Zimin 16 Apr. 1971 228 p refs Transl. into ENGLISH of the book "Prakticheskaya Aerodinamika i Letatelnye Apparaty" Moscow, Red Banner Military Publishing House, 1969 p 1-324 (AD-726580; FTD-HC-23-638-70) Avail: NTIS CSCL 01/1

The monograph is written primarily as an aid to pilots and is divided into three main sections. Part 1 concerns aerodynamic and flight characteristics of supersonic aircraft, with information on the aerodynamics of supersonic velocities and characteristics of the aerodynamic layout and piloting of supersonic aircraft in takeoff and landing stability and controllability at different flight regimes. Part 2 deals with the future development of piloted aircraft giving the basic flight-tactical characteristics of piloted aircraft. Part 3 involves the basic concepts concerning the motion of spacecraft in the gravitational field of planets. Author (GRA)

N71-35225# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div. **AIRCRAFT ELECTRIFICATION IN CLOUDS AND PRECIPITATION**

I. M. Imyanitov 1 Apr. 1971 267 p refs Transl. into ENGLISH from the book "Elektrizatsiya Samoletov v Oblakakh i Osadkakh" Leningrad, 1970 p 1-211 (AD-726581; FTD-HC-23-544-70) Avail: NTIS CSCL 04/1

When flying in the clouds or during rainfall there may appear corona or even sparks on the surface of the airplane. As a result, strong statics develop, which increase the probability of hitting the airplane by lightning. In some cases, the aerodynamics of the airplane may be subjected to changes. The electrification of the airplane may distort the results of micro-physical observation of the clouds, particularly the measurement of the atmospheric electricity. This volume is the first attempt to cover the subject in all meteorological aspects. An analysis is given of the static electrification of the airplane and cloud parameters is discussed. Experimental data on electrification in different meteorological conditions are given. Author (GRA)

N71-35226# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab. **COMPARISON BETWEEN EXPERIMENTAL DATA AND HELICOPTER AIRLOADS CALCULATED USING A LIFTING SURFACE THEORY**

Wayne Johnson Jul. 1970 28 p refs (Contract N00019-69-C-0219)

(AD-726717; ASRL-TR-157-1) Avail: NTIS CSCL 01/1

Results of the calculation of helicopter airloads using a lifting surface theory solution are presented and compared with experimental data. These results indicate that a very accurate wake geometry model will be required in order to make full use of the accuracy of the lifting surface theory solution. It is observed that the experimental vortex induced loads decrease as the vortex moves inboard along the blade; this phenomenon in the behavior of the vortex wake of a rotor requires more investigation. Author (GRA)

N71-35227# Army Test and Evaluation Command, Aberdeen Proving Ground, Md. **AIRCRAFT REFUELING/DEFUELING SYSTEMS Final Report**

1 Jul. 1971 17 p

(AD-726872; MTP-7-3-054) Avail: NTIS CSCL 01/3

The document defines procedures to be used in service testing aircraft refueling/defueling systems. Author (GRA)

N71-35228# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.

LONG-LINE LOITER: PERSONNEL RETRIEVAL SYSTEM Final Report

Edward A. Behling Mar. 1971 24 p refs

(AD-727007; AMRL-TR-69-140) Avail: NTIS CSCL 06/7

The report covers the use of fixed-wing aircraft employing innovations to free fall and circling-line techniques in the rescue of personnel and delivery and retrieval of equipment. The technique involves the deployment of a line from the aircraft while a controlled turn is maintained, causing the line to describe a diminishing spiral earthward. Successful launches of dummy weights up to 203 pounds suggest this technique can feasibly be employed in personnel rescue. Included in the testing were various aircraft, altitudes, speeds, lines, and line lengths. Line tensions were measured. Proposed future efforts toward man-rating the system include measurements of launch G forces and the assessment of system reliability. Author (GRA)

N71-35229# Illinois Univ., Urbana. Aviation Research Lab. **AN EXPERIMENTAL INVESTIGATION OF TWO LINEAR RATE FIELD DISPLAYS** Technical Report, 1 Dec. 1969 - 30 Nov. 1970

Leon E. Swartzendruber, Fuat Ince, Robert C. Williges, and Stanley N. Roscoe Wright-Patterson AFB, Ohio AFFDL May 1971 37 p refs

(Contract F33615-70-C-1165)

(AD-726643; ARL-71-0007; AFFDL-TR-71-1; AFFDL-TR-71-25)
 Avail: NTIS CSCL 01/4

An airspeed display and a lateral displacement (runway) display, arranged vertically and horizontally, respectively, were concurrently tracked by relatively inexperienced pilots using a joy stick. On each display the primary indication was a small band which moved lengthwise. A moire-pattern rate field (RF) moved alongside and with the primary. Each of four experimental conditions included the primary and (a) no RFs, (b) the airspeed RF only, (c) the runway RF only, or (d) both RFs. Response measures for each display include (a) root mean square (RMS) tracking error, (b) latency of initial response, and (c) control reversals. RFs decreased RMS error for the runway display. Latency was faster, and more reversals occurred on the airspeed display than on the runway display. RFs apparently serve an attention gathering function, but this cannot be fully investigated until optimum direction-of-motion relations are determined.

Author (GRA)

N71-35280# Air Force Human Resources Lab., Williams AFB, Ariz. Flying Training Div.

AIRBORNE AUDIO-VIDEO RECORDING DESIGN CONSIDERATIONS

Milton E. Wood and William V. Hagin Nov. 1970 20 p
 (AD-727025; AFHRL-TR-70-33) Avail: NTIS CSCL 14/3

A brief summary of recent airborne audio-video recording research is presented. Based on this research, and recent Air Training Command requirements for an operational airborne audio-video recording system, discussion is presented which considers the several design goals which are involved in the design of any airborne audio-video recording system. Further, an engineering development philosophy is provided which weighs current requirements against various aspects of the state of the art in audio-video technology.

Author (GRA)

N71-35384*# McDonnell-Douglas Co., St. Louis, Mo. Advanced Engineering.

HYPERSONIC RESEARCH FACILITIES STUDY. VOLUME 1: Summary

2 Oct. 1970 87 p
 (Contract NAS2-5458)

(NASA-CR-114322; MDC-A0013-Vol-1) Avail: NTIS CSCL 14B

The research and development requirements for hypersonic aircraft were assessed to provide NASA with descriptions of desirable hypersonic research facilities, and estimates of performance, costs, development schedules, and capabilities. It is concluded that a sound engineering, cost, and planning basis was established for the acquisition of new hypersonic research facilities when the need is appropriate.

F.O.S.

N71-35385*# Analytical Mechanics Associates, Inc., Mountain View, Calif.

A STUDY OF TECHNIQUES FOR CALCULATING MOTION-DRIVE SIGNALS FOR FLIGHT SIMULATORS

Bjorn Conrad and Stanley F. Schmidt Jul. 1971 81 p refs
 (Contract NAS2-5816)

(NASA-CR-114345; Rept-71-28) Avail: NTIS CSCL 14B

An experimental test plan was developed using the formation-flying task for the validation and refinement of washout circuits (solutions of the motion drive problem). The test plan was executed in conjunction with NASA scientists and test pilots and the results obtained are given. Certain general concepts were also tested, such as the feasibility of motion cue scaling in preferred coordinates, and the usefulness of formation-flying as an experimental tool for motion testing. Some of the results include: (1) a demonstration of the effectiveness of angular-rate and force scaling as a motion attenuation device in realistic simulations, (2) the mechanization and validation of two washout circuits for the All-Axis Motion Generator, and (3) the determination of circuit parameters that can serve as initial trial values for a wide variety of tasks.

D. L. G.

N71-35386*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

GENERAL THEORY OF WALL INTERFERENCE FOR STATIC STABILITY TESTS IN CLOSED RECTANGULAR TEST SECTIONS AND IN GROUND EFFECT

Harry H. Heyson Washington Sep. 1971 331 p
 (NASA-TR-R-364; L-7549) Avail: NTIS CSCL 14B

A theory is developed which predicts the interference velocities and interference velocity gradients caused by the walls of the tunnel. Large wake deflections are allowed in both the lateral and vertical directions. The theory includes V/STOL and conventional wall-interference theories and ground effect as special cases. Symmetry and interchange relationships between the interference factors are developed and extensive numerical results are presented. Use of the interference factors to correct data depends upon the availability of detailed aerodynamic treatments in nonuniform flow of the model under test. In most tests the available aerodynamic treatments will be found either inadequate or too time consuming for rigorous routine correction of data relating to lateral-directional stability.

Author

N71-35391# West Valley Planning Agency, Calif.

ONTARIO INTERNATIONAL AIRPORT IMPACT STUDY, WEST VALLEY, CALIFORNIA

1971 61 p refs Sponsored by Dept. of Housing and Urban Develop.

(PB-199695) Avail: NTIS CSCL 13B

The plans for an international airport to be constructed at Ontario, California are discussed. Subjects involved in site selection and development are described. Employment and population growth trends for the area and the impact on the future of the airport are considered.

P.N.F.

N71-35393# Little (Arthur D.), Inc., Cambridge, Mass.

ANALYTIC TOOLS FOR THE STUDY OF AIRPORT CONGESTION Interim Report, Oct. 1970 - Sep. 1971

Bernard O. Koopman Sep. 1971 60 p refs
 (Contract DOT-FA70WA-2141)

(FAA-RD-71-55) Avail: NTIS

In the analysis of air terminal congestion two distinct interlocking systems have to be considered: (1) the air traffic control system, with its sensors, communication links, computers and displays; and (2) the mechanical system composed of the runways, the ground and air space surrounding them, and the aircraft in their various states of takeoff and waiting for takeoff, of landing, joining the landing pattern, in stacks and so on. The tools of analysis developed in the present report are concerned with the second of these systems, in which the phenomena of congestion are in fact the phenomena of waiting lines and their interactions. A set of tools for calculating the quantitative effects on the performance of the air terminal of various assumed conditions, operational options, and suggested technical improvements is described. The effects on the performance are to be expressed in terms of throughput rates, delay reductions, and diminished numbers of aircraft not accommodated.

Author

N71-35396# Cincinnati Univ., Ohio. Design Research Collaborative.

RESEARCH, DESIGN, FABRICATION, AND FIELD TESTING OF A NINETY FOOT SPAN, TWO ARCH EVALUATION SEGMENT, AIRCRAFT MAINTENANCE HANGAR, VOLUME 2 Final Technical Report, 15 Oct. 1969 - 1 Sep. 1970

James M. Alexander, Lawrence E. Spreckelmeier, Bahram Bahramian, and David L. Hunt Wright-Patterson AFB, Ohio AFSC Feb. 1971 153 p refs

(Contract AF 33(615)-3242)

(AD-727051; ASD-TR-71-2-Vol-2) Avail: NTIS CSCL 01/5

A lightweight, 100% recoverable, air-transportable hangar, large enough to accommodate any aircraft up to the size represented by the F-15 and F-111 is needed by the Air Force as part of the inventory of mobility equipment. The concept

utilized in the ninety (90) foot span hangar is the same basic system used in the fifty-eight (58) foot span hangar. The concept utilizes sectional arches of aluminum I-beams and 3/4 in. thick modular sandwich panels of polystyrene foam or paper honeycomb faced with sheet aluminum. Arch segments are connected with pairs of aluminum hinges, and the adjacent panels are fastened to the beams with camlocks. Variable length spacers between the arches allow for adjustment to minor terrain variations. A full size two-arch evaluation segment was constructed and field tested. Author (GRA)

N71-35397# Cincinnati Univ., Ohio. Design Research Collaborative.

RESEARCH, DESIGN, FABRICATION, AND FIELD TESTING OF 50 BY 80 FEET AIRCRAFT MAINTENANCE HANGARS AND 30 BY 45 FEET GENERAL PURPOSE SHELTERS, VOLUME 1 Final Technical Report, 15 Oct. 1965 - 15 Nov. 1969

James M. Alexander, John R. McKnight, Karl H. Merkel, and Bahram Bahramian Wright-Patterson AFB, Ohio AFSC Dec. 1970 309 p refs

(Contracts AF 33(615)-3242; F33615-67-C-1259)

(AD-727047; ASD-TR-70-26-Vol-1) Avail: NTIS CSCL 13/13

Aircraft maintenance hangars (50 to 60 ft. span) and general purpose shelters (24 to 30 ft. span) are needed by the Air Force as part of the inventory of mobility equipment. Several concepts are presented. Studies were made for hangars utilizing double curvature modular panels which, when joined together, would form a structurally sound vault. Panels were fiberglass reinforced polyester skins on 1-3/4 in. thick paper honeycomb cores. Panel sizes were limited by the 463 L pallet system. The complexity of integral connecting hardware required to transmit the design stresses rendered this approach uneconomical. A variation utilizing aluminum skins on 3 in. thick single curvature cores resulted in excessive cubage in the packaged mode. A concept utilizing sectional arches of aluminum I-beams and 3/4 in. thick modular sandwich panels proved much more successful. Author (GRA)

N71-35398# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.

MEMBRANE, AIRFIELD SURFACING Final Report

1 Jul. 1971 19 p

(AD-726891; MTP-7-3-071) Avail: NTIS CSCL 01/5

The procedure describes test methods and techniques for evaluating membrane, airfield surfacing, and for determining their suitability for service use by the U. S. Army. Author (GRA)

N71-35420# Polytechnic Inst. of Brooklyn, Farmingdale, N.Y. Dept. of Aerospace Engineering and Applied Mechanics.

NUMERICAL METHODS FOR TWO- AND THREE-DIMENSIONAL VISCOUS FLOW PROBLEMS: APPLICATION TO HYPERSONIC LEADING EDGE EQUATIONS Interim Progress Report

S. G. Rubin and T. C. Lin Apr. 1971 114 p refs

(Grant AF-AFOSR-1843-70)

(AD-726547; PIBAL-71-8; AFOSR-71-0778TR) Avail: NTIS CSCL 20/4

Several explicit and implicit finite-difference methods, useful for treating two- and three-dimensional viscous flow problems, are compared. These techniques are applied to the single-layer equations previously developed by the authors for continuum leading-edge studies. Stability and accuracy of different schemes, effects of linearization, boundary conditions, coordinate systems and grid size, and the need for iteration are discussed. Solutions are presented for equilibrium and rotational non-equilibrium flow fields and comparisons with experimental data are provided. Different models for the pressure gradient (px) term in the streamwise momentum equation are discussed and it is shown that the effects of upstream influence appear in certain px

representations that may be useful when these effects are important. The relationship to so-called sub- or super-critical flows is demonstrated. For three-dimensional geometries, a new predictor-corrector method is devised and tested for stability properties. For a right-angle corner geometry, solutions are compared with explicit results obtained with step sizes three orders of magnitude smaller. The need for iteration in obtaining accurate and consistent results is emphasized. The use of these techniques for two-dimensional unsteady Navier-Stokes solutions is discussed. Author (GRA)

N71-35421# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

METHOD OF DETERMINING THE VELOCITY PULSATION OF THE EFFECTIVE FLOW OF A HYPERSONIC WIND TUNNEL

L. V. Novikov et al 22 Jan. 1971 10 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Tekhn. (USSR), n. 3, 1969 p 16-19

(AD-726605; FTD-HC-23-668-70) Avail: NTIS CSCL 14/2

Development is reported of a method of studying the velocity pulsations of a high-temperature hypersonic flow, based on the existence of an interrelation between the total stagnation pressure pulsations behind the direct shock and the longitudinal velocity pulsations. The theoretical possibility of studying velocity pulsations of a hypersonic working flow in an aerodynamic facility with the aid of miniature pressure transducers is shown. The method developed makes it possible to obtain data concerning the velocity pulsations of a hypersonic working flow with an rms error in amplitude of plus or minus 26 percent and an rms error in frequency of plus or minus 1.5 percent in the frequency range from 20-6000 Hz and with an rms error in amplitude of plus or minus 7 percent and an rms error in frequency of plus or minus 0.3 percent in the frequency range from 0 to 120 Hz. Author (GRA)

N71-35447# Purdue Univ., Lafayette, Ind. Joint Highway Research Project.

REMOTE SENSING AND DEVELOPMENT OF ANNOTATED AERIAL PHOTOGRAPHS AS MASTER SOIL PLANS FOR PROPOSED HIGHWAYS Final Report

Robert D. Miles, Harold T. Rib, and Marc G. Tanguay 16 Jul. 1970 60 p refs

(PB-199422) Avail: NTIS CSCL 08B

The application of remote sensing systems to the development of master engineering soil plans is discussed. The remote sensing systems consisted of aerial photography, infrared imagery, side-looking airborne radar imagery and multispectral imagery. The multispectral analog data were used in conjunction with a digital computer to semi-automatically produce thematic maps and statistical analysis of reflectance of surfaces. Inference techniques were used to evaluate the photography and imagery. Author (GRA)

N71-35453# National Oceanic and Atmospheric Administration, Miami, Fla. Environmental Research Labs.

THE NOAA RESEARCH FLIGHT FACILITY'S AIRBORNE DATA COLLECTION PROGRAM IN SUPPORT OF THE BARBADOS OCEANOGRAPHIC AND METEOROLOGICAL EXPERIMENT

Howard A. Friedman, John D. Michie, and James D. McFadden Oct. 1970 185 p refs

(NOAA-TR-ERL-198-RFF-4) Avail: SOD \$1.50

The three Research Flight Facility (RFF) aircraft, supporting the overall program of BOMEX, flew 146 missions for approximately 1138 hours. During these flights, almost three million digitally recorded meteorological observations, numerous sea-surface temperature and water vapor flux measurements, over two million cloud and radar photographs, and other special data were obtained for subsequent analysis and research application. The scientific objectives of the program, the RFF aircraft capabilities, and the instrumentation systems that

supported BOMEX are briefly described. An inventory of the BOMEX field experiment data collected by the RFF from May through July 1969 is given. Author

N71-35485# Department of Highways, Ontario, Downsview.
TRANSPORTATION AIR POLLUTION
M. D. Harmelink and W. J. Peck Jun. 1971 35 p refs
(DHO-RR169) Avail: NTIS

A brief state-of-the-art survey of transportation air pollution is presented. First, the primary types of transportation pollutant are described, namely, hydrocarbons, nitrogen oxides, oxidants, carbon monoxide, sulfur oxides, lead, and particulate matter. Methods of measurement are listed and emission rates for various travel modes (automobiles, diesel trucks and busses, railway, and aircraft) are discussed. The effects of these primary pollutants on health, psyche, vegetation, and materials are described. Finally, various solutions to transportation air pollution are discussed, ranging from automobile emission controls and alternatives to the spark-ignited internal combustion engine to increasing use of public transportation, development of new modes of public transportation, and consideration of air pollution in transportation planning. Author

N71-35494# Naval Intelligence Command, Alexandria, Va. Translation Div.

THE PROBLEM OF INCREASING THE ACCURACY OF MEASUREMENT OF THE SURFACE TEMPERATURE OF SEAS AND OCEANS BY MEANS OF AN AIRBORNE INFRARED RADIOMETER [K VOPROSU OB UVELICHENII TOCHNOSTI IZMERENIYA TEMPERATURA POVERKHOСТИ MOREY I OKEANOV S POMOSHCHYU INFRAKRASNOY RADIOMETRICHESKOY APPARATURY SSAMOLET-A]

N. Verenchikov 16 Jul. 1971 13 p refs Transl. into ENGLISH from TR. Gl. Geofiz. Observ. (Leningrad), no. 235, 1970 p 146-154

(AD-726512; NIC-Trans-3228) Avail: NTIS CSCL 08/10

The use of infrared radiometric apparatus to measure the surface water temperature of seas and oceans is seeing increased use at the present time in the Soviet Union and abroad. Its installation aboard aircraft allows data to be collected from large areas in a short period of time. It is extremely important that the measurement errors be as small as possible. The errors in measurement may be divided into static and dynamic varieties. Static errors include those involving errors in the apparatus itself and those which are caused by the effect of the atmosphere on the measurement results; dynamic errors are encountered in connection with averaging the water surface temperature due to the finite dimensions of the field of vision of the apparatus and its inertia. Author (GRA)

N71-35546*# Monsanto Research Corp., Dayton, Ohio.
THERMALLY RESISTANT POLYMERS FOR FUEL TANK SEALANTS Annual Summary Report, 1 Jul. 1970 - 28 Jun. 1971

James A. Webster and Thomas J. Morrow Jul. 1971 79 p refs

(Contract NAS8-21401)

(NASA-CR-119940; ASR-3; MCR-DA-301) Avail: NTIS CSCL 11A

The development of imide, isocyanate, and siloxane linked fluorocarbon polymers for use as sealants in fuel tanks of advanced high speed aircraft is described. Synthesis and polymerization of polymer intermediates representing perfluoro alkylene and perfluoro alkylene ether segments and amine, isocyanate, or silyl groups are discussed. Polymer evaluations including thermal and oxidative stability, fuel resistance, and stress corrosion of a titanium alloy are discussed. Author

N71-35558# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.

TOOLS, AVIATION Final Report

1 Jul. 1971 36 p.

(AD-726893; MTP-7-2-057) Avail: NTIS CSCL 13/9

The procedure provides techniques for evaluating hand tools used in support of aircraft maintenance. Author (GRA)

N71-35735# Rowland and Co., Haddonfield, N.J.

ANALYSIS OF VFR CLOUD CLEARANCE AND VISIBILITY STANDARDS Final Report

George E. Rowland and Carl T. Reichwein Sep. 1971 120 p refs

(Contract DOT-FA69NA-357)

(FAA-RD-70-48; FAA-NA-71-35) Avail: NTIS

A three-dimensional vector analysis of a two-aircraft near-miss geometry was developed and used to generate a numerical safety rating scheme for quantifying the degree of hazard associated with aircraft-to-cloud separation minimums and with speed-visibility restrictions. Hazard functions were generated for low, medium, and high-speed aircraft. Based upon the resulting data, proposed new Visual Flight Rules were created. The rationale behind the new rules is discussed. Possible effects of the rules are noted. Numerous inadequacies of the data which was inserted in the limited mathematical model are indicated. Additional research needs are sketched. Concern over the broad impact of the proposed new VFR rules, coupled with reservations about the limited scope of the study and the paucity of hard data to incorporate into and actually test out the validity of the model, cause the authors to suggest the firm necessity of substantial additional technical investigation and broad discussion prior to adoption of the new rules. Author

N71-35770*# Texas Instruments, Inc., Dallas. Equipment Group.

VHF NAVIGATION EXPERIMENT Final Report, Sep. 1969 - Dec. 1970

John F. DuBose, R. A. Wheeldon, J. L. Coates, C. B. Wason, R. L. Clark et al May 1971 156 p refs

(Contract NAS5-21079)

(NASA-CR-121977; U9-832400-F) Avail: NTIS CSCL 17G

The results of an experiment to determine the accuracy that could be obtained in locating the position of an aircraft when using sidetone ranging signals relayed by two synchronous satellites, ATS-1 and ATS-3 are presented. A real-time display system was developed that allowed the aircraft position, as derived by the satellite system, to be compared with that derived from an airport surveillance radar. It was demonstrated that the use of differential position location techniques could provide location accuracy of 3 nautical miles. Author

N71-35773# National Aviation Facilities Experimental Center, Atlantic City, N.J.

MINIMIZE SNOW AND WEATHER EFFECTS-VORTAC TASK 2 TACAN ANTENNA Interim Report, May 1968 - Aug. 1971

G. J. Hartman Sep. 1971 24 p ref

(FAA-RD-71-56; FAA-NA-71-4) Avail: NTIS

The various techniques used to minimize the effects of snow and ice on the RTA-2 TACAN antenna are discussed. The techniques were: (1) a wire-wrapped radome with current flowing through the wires attached to the external surface of the radome; (2) enlarge radomes; (3) coating existing radome with hydrophobic materials; and (4) providing a polyurethane shroud over the existing radome with movement of the shroud provided by antenna vibration, wind, or air inflation. The polyurethane shroud showed the most promise of all the techniques tested. Author

N71-35777# Airborne Instruments Lab., Deer Park, N.Y.
DEVELOPMENT PROGRAM ADVANCED INTEGRATED

LANDING SYSTEM (AILS)

John L. O'Connor Sep. 1971 180 p
(Contract DOT-FAWA-4616)
Avail: NTIS

The design, development, and field and flight tests of an all-weather landing system developed for the FAA are described. This system, which uses scanning microwave antennas, provides precision azimuth, elevation, and range guidance information to equipped aircraft, and also provides aircraft space position information to a ground monitor radar console. Basic design information is provided on the system and the various units that make up the system. A description of the delivered equipment is also presented. Various tests that were conducted with the equipment, in order to indicate conformity with the contract specification, are also described. Although limited in scope, the tests indicated performance better than specified, with one-sigma standard deviations of 0.028 degree in elevation angle, 0.021 degree in azimuth angle, and 75 feet in range. It is concluded that the objectives of the development and test program to provide highly accurate space position data for guidance and control of approaching and landing aircraft to touchdown were met.

Author

N71-35779# National Aviation Facilities Experimental Center, Atlantic City, N.J.

TASK 1, TEST AND EVALUATION OF SOLID STATE 100 WATT VOR TRANSMITTING EQUIPMENT Final Report
Mar. 1969 - Aug. 1971

Barry S. Brayer Sep. 1971 38 p
(FAA-RD-71-65; FAA-NA-71-13) Avail: NTIS

The development and testing of a 100-watt solid state VHF omnirange (VOR) transmitter are discussed. The VOR provides azimuth guidance to enroute aircraft in the national airspace system. The transmitting system tested is used to generate signals. Results of the tests provide data for establishing specifications for the next generation of VOR transmitting equipment.

Author

N71-35782# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

AIR NAVIGATION, CHAPTER 7

V. I. Osadshii et al 9 Feb. 1971 35 p Transl. into ENGLISH from the book "Vozdushnaya Navigatsiya" Moscow, Isp-Vo transport, 1969 p 228-249

(AD-726603; FTD-MT-24-340-70) Avail: NTIS CSCL 17/7

The methods of automatic coordinate reckoning continue to be improved on the basis of the success of aviation automation using analog and digital resolving devices having various electronic (including micromodular) elements and units. There are numerous versions of instruments which perform the automatic computation of current MS coordinates. They receive from organizations-manufacturers in various designations: ground-position indicators, navigation indicators, navigation computers, automatic navigation devices, avigraphs, navigation independent system, and others. The questions of navigational use of only the geotechnic coordinate computers are considered which completely pertain to the use of more recent computers during their work in emergency conditions of the independent navigation system NAS-1.

Author (GRA)

N71-35980# Edgerton, Germeshausen and Grier, Inc., Las Vegas, Nev.

USE OF AERIAL SURVEYS FOR DETERMINING PLUTONIUM CONCENTRATION

T. P. Stuart 29 Apr. 1971 10 p Presented at the Symp. on Safety in Plutonium-handling Facilities, Rocky Flats, Colo. 15 Apr. 1971

(EGG-1183-1517; Conf-710401-2; L-1030) Avail: NTIS

A Pu aerial survey using an array of NaI detectors that are set up to sense the 60 KeV gamma ray from Am-241, a decay

product of Pu-241 is described. The detecting system was mounted inside an Air Force helicopter and flown over known concentrations at the Nevada Test Site.

Author (NSA)

N71-36120*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

NASA TURBINE COOLING RESEARCH STATUS REPORT, 1971

John N. B. Livingood, Herman H. Ellerbrock, and Albert Kaufman Washington Sep. 1971 83 p refs
(NASA-TM-X-2384; E-6164) Avail: NTIS CSCL 21E

The turbine cooling program, including research in progress and research being performed for Lewis, is discussed. The report represents the status of work through April 1971. From comparisons of predicted and experimental results, areas requiring further research efforts are identified. Flow, heat-transfer structure, and life considerations are presented. Cooling concepts for application to future aircraft engines are also discussed.

Author

N71-36253*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

NASTRAN: USERS' EXPERIENCES

Washington Sep. 1971 785 p refs Colloq. held at Hampton, Va., 13-15 Sep. 1971

(NASA-TM-X-2378; L-7980) Avail: NTIS HC \$9.00/MF \$0.05 CSCL 20K

The application of the NASTRAN computer program to a wide variety of static and dynamic structural problems is discussed. The conference papers presented focus on vibrations, structural design, systems and operational problems, evaluations and innovations, and new capabilities for NASTRAN.

N71-36260*# Vought Aeronautics, Dallas, Tex.

NASTRAN DIFFERENTIAL STIFFNESS ANALYSIS OF AN AIRCRAFT CANOPY

Robert D. Bennett /n NASA, Langley Res. Center NASTRAN: Users Experiences Sep. 1971 p 85-105 ref

Avail: NTIS HC \$9.00/MF \$0.95 CSCL 20K

Comparisons of internal member loads and stresses as generated by the NASTRAN differential stiffness and static analysis methods are presented for a tandem side opening canopy. A description of the structure analyzed and the load condition for which it is analyzed are included along with several computer and hand generated plots. The comparisons of the two methods show a general decrease in the internal member loads obtained by the differential stiffness method of analysis over the static method of analysis.

Author

N71-36269*# Naval Air Development Center, Johnsville, Pa.
STATIC AND DYNAMIC ANALYSIS, F-14A BORON HORIZONTAL STABILIZER

S. L. Huang and H. Rubin /n NASA, Langley Res. Center NASTRAN: Users Experiences Sep. 1971 p 251-264

Avail: NTIS HC \$9.00/MF \$0.95 CSCL 01A

A static stress analysis and a dynamic modal analysis of the horizontal stabilizer of the F-14A aircraft has been conducted employing the NASTRAN program. The structural model contains 1518 elements including bars, rods, shear panels and orthotropic and isotropic membrane elements with 1357 degrees of freedom. Static deflection and stresses, including thermal stresses, under maximum load at room and at elevated temperatures are calculated and results are in good agreement with experimental data. Through application of Guyan Reduction the number of degrees of freedom used in the dynamic analysis is reduced to 137. The frequencies and mode shapes for the first two modes are obtained.

Author

N71-36273*# National Aeronautics and Space Administration.
Langley Research Center, Langley Station, Va.
**MODAL ANALYSIS OF A NINE-BAY SKIN-STRINGER
PANEL**

Robert E. Grandle and Carl E. Rucker *In its* NASTRAN: Users
Experiences Sep. 1971 p 343-361
Avail: NTIS HC \$9.00/MF \$0.95 CSCL 20K

The results obtained using a NASTRAN normal mode analysis of a nine-bay skin-stringer panel 68.58 cm (27 inches) by 93.98 cm (37 inches) of typical aircraft construction are presented. The aluminum panel was made up of a plate, Z section stringers, and channel section frames and was assumed to have fully fixed edges. Stress and mode shape data for the lower order modes obtained from a NASTRAN analysis of a 286-grid-point division of the panel are presented and compared with experimental data. Author

N71-36276*# National Aeronautics and Space Administration.
Langley Research Center, Langley Station, Va.
**APPLICATIONS OF NASTRAN TO COUPLED STRUC-
TURAL AND HYDRODYNAMIC RESPONSES IN AIR-
CRAFT HYDRAULIC SYSTEMS**

James T. Howlett *In its* NASTRAN: Users Experiences Sep.
1971 p 407-419 refs
Avail: NTIS HC \$9.00/MF \$0.95 CSCL 20K

It is demonstrated that the NASTRAN computer program can be used to analyze the coupled fluid and structural responses of multibranch pipes as occur in aircraft hydraulic systems. The techniques used to model hydraulic lines with NASTRAN are explained. Example problems are presented which demonstrate the validity of the analytical model for a simple standpipe system and which demonstrate that the technique is promising as a basis for detailed dynamic analysis of hydraulic systems of actual aircraft. Author

N71-36280*# National Aeronautics and Space Administration.
Langley Research Center, Langley Station, Va.
**NASTRAN AS ANALYSIS TOOL IN A STRUCTURAL
DESIGN OPTIMIZATION PROCESS**

J. E. Sobteszczanski and D. D. Loendorf (Army Air Mobility Res.
and Develop. Lab., Fort Eustis, Va.) *In its* NASTRAN: Users
Experiences Sep. 1971 p 465-478 refs

Avail: NTIS HC \$9.00/MF \$0.95 CSCL 20K

The use of NASTRAN as the analysis tool in a structural design process is described. A section of an aircraft fuselage type structure with rings, stringers, and skin idealized by 408 finite elements and 858 degrees of freedom was optimized in an analysis evaluation and redesign closed cycle. NASTRAN was employed in the analysis step, with the evaluation and redesign steps supported by separate programs, and data transfer was carried out by hand. This procedure proved to be workable with turn-around time for one redesign cycle requiring one day. Approximately five redesign cycles were needed to converge to an optimized design. Author

N71-36282*# Lockheed-California Co., Burbank.
**THE USE OF NASTRAN IN THE ANALYSIS OF LARGE
COMPLEX AIRFRAME STRUCTURES: MODELING
TECHNIQUES AND ORGANIZATION**

Gernot W. Haggemacher *In* NASA. Langley Res. Center
NASTRAN: Users Experiences Sep. 1971 p 493-515

Avail: NTIS HC \$9.00/MF \$0.95 CSCL 01A

The NASTRAN system has been found to be very versatile, fairly easy to use when following the rigid format, with many outstanding features, and as a practical tool for large scale aircraft analysis. A brief evaluation of the NASTRAN system based predominantly on a large airframe analysis is presented. E.M.C.

N71-36284*# Boeing Co., Renton, Wash.
**DATA MANAGEMENT REQUIREMENTS FOR LARGE
PROBLEMS** c08

Stanley D. Hansen and Harold B. Hansteen *In* NASA. Langley
Res. Center NASTRAN: Users Experiences Sep. 1971
p 533-550

Avail: NTIS HC \$9.00/MF \$0.95 CSCL 09B

It is recommended that the NASTRAN computer code can be configured to interface with the requirements of other finite element computer programs utilized in production analyses such as those employed in the 747 and SST airframes. Substructuring is also shown to be a necessary tactic for the processing of large finite element problems. E.M.C.

N71-36290*# McDonnell-Douglas Astronautics Co., Huntington
Beach, Calif.

**AN EVALUATION OF CURRENT NASTRAN DISCRETE
ELEMENT MODELS FOR MONOCOQUE AND SEMIMONO-
COQUE STRUCTURES**

Edward L. Stanton and William F. Bozich *In* NASA. Langley
Res. Center NASTRAN: Users Experiences Sep. 1971
p 587-625 refs

(Contracts NAS9-6555; F04701-70-c-0159)

Avail: NTIS HC \$9.00/MF \$0.95 CSCL 20K

The current discrete element analysis models in NASTRAN, Levels 8.1.0 and 11.1.0, are evaluated for semi-monocoque and monocoque structures. Comparative results are presented with the FORMAT-3 general-purpose code for a swept wing statics analysis and a Skylab substructure vibration analysis. Good agreement between Level 11.1.0 and FORMAT-3 is demonstrated; however, a major error in Level 8.1.0 was discovered on the Skylab vibration problem. The computational performance of NASTRAN was superior to FORMAT, but the vibration rigid format was found to have several inefficiencies. Comparative results are also presented between Level 11.1.0 and STACUSS, SLADE, BOND, UNIVALVE, and another special-purpose code. Results for two of the structures analyzed, a cylindrical shell and an elliptic plate, indicate curved discrete elements are significantly more accurate than the plate elements in NASTRAN for the same number of degrees of freedom. Author

N71-36293*# National Aeronautics and Space Administration.
Langley Research Center, Langley Station, Va.

**VIBRATION STUDIES OF A FLAT PLATE AND A
BUILT-UP WING**

James H. Starnes, Jr. *In its* NASTRAN: Users Experiences Sep.
1971 p 637-646 refs

Avail: NTIS HC \$9.00/MF \$0.95 CSCL 01A

The natural vibration frequencies of a clamped flat plate and a built-up wing were computed by two different finite element computer programs and compared with existing experimental data. The results indicate that by using a finite element program it is possible to obtain the accuracy desired for parametric design studies even for complex built-up structures. However, the differences in central processing unit execution times between the two programs revealed that it is economically feasible to develop automated design procedures or make parametric design studies involving many iterations only if computer programs tailored for very efficient operation are available. Author

N71-36299*# Computer Sciences Corp., Silver Spring, Md.
NASTRAN PLOTTING CAPABILITIES c08

John R. McDonough *In* NASA. Langley Res. Center NASTRAN:
Users Experiences Sep. 1971 p 709-735 refs

Avail: NTIS HC \$9.00/MF \$0.95 CSCL 09B

Plotting improvements and techniques for NASTRAN static, modal and transient analyses plots are discussed. The five common software functions performed by all the plot generating routines are reviewed. Static rigid, modal rigid, and transient

rigid format plotting are illustrated using a delta wing analysis problem.
J.M.

N71-36323# Battelle Memorial Inst., Columbus, Ohio.
**ANALYSIS AND CHARACTERIZATION OF MATERIALS
SUITABLE FOR AIRCRAFT STRUCTURE** Final Report,
Nov. 1966 - Apr. 1970
William M. Henry, Ellsworth R. Blosser, Donald K. Landstorm,
and Richard E. Heffelfinger Jan. 1971 30 p refs
(Contract F33615-67-C-1166)
(AD-727017; ARL-71-0014) Avail: NTIS CSCL 14/2

The report provides descriptions and discussion of the analytical methodologies used most extensively during 4 years of chemical and structural analysis effort carried out in cooperation with the materials research program of Aerospace Research Laboratories.
Author (GRA)

N71-36381# Aircraft Research Association, Ltd., Bedford
(England).
**REPORTS CATALOGING AT THE AIRCRAFT RESEARCH
ASSOCIATION**
C. C. Barnett Jul. 1971 19 p refs
(Rept-22) Avail: NTIS

A computer produced cataloging and subject indexing system for report material acquired by the Aircraft Research Association Library is described. Keyword listings with indexes under author and originators, references will be used to produce a monthly accessions list, monthly and annual cumulating catalogs. The keywords will be supplied manually by using a specially constructed thesaurus.
Author

N71-36387# National Industrial Pollution Control Council,
Washington, D.C.
**EXHAUST EMISSIONS FROM GAS TURBINE AIRCRAFT
ENGINES**
Feb. 1971 28 p
Avail: NTIS

Air pollution by gas turbine aircraft engines is discussed. The emissions that are considered air pollutants, include: smoke and particulate matter, carbon monoxide, nitrogen oxides, unburned and partially oxidized hydrocarbons, and sulfur oxides. The emission extent, airport conditions, odors, and fuel vapors are also discussed. It is recommended that programs to obtain better definition of the meteorology and atmospheric chemistry and physics in the upper atmosphere should be accelerated.
F.O.S.

N71-36388# National Industrial Pollution Control Council,
Washington, D.C.
NOISE FROM GAS TURBINE AIRCRAFT ENGINES
Feb. 1971 24 p
Avail: NTIS

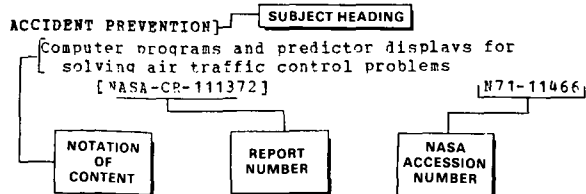
The reduction of aircraft noise at airports is discussed in terms of jet exhaust noise. Improvements to suppress noise are presented and include the operational procedures of routing approach and takeoff turns away from populated areas. It is concluded that no immediate breakthroughs are foreseen and further noise reduction will be achieved only in small increments.
F.O.S.

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AERONAUTICAL ENGINEERING / A Special Bibliography (Suppl. 12)

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A

ACCIDENT PREVENTION

Military pilot handling characteristics, discussing combat operations, accident prevention and blind landing

A71-42239

ACOUSTIC MEASUREMENTS

Propeller vortex noise analysis by on-line 1/3 octave band resolution, discussing characteristic results from noise measurements on various propeller configurations

A71-40868

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Aircraft noise effects on hearing acuity and perceptual and intellectual judgment tasks

A71-40351

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A71-40701

Aerial photographic equipment survey, describing topographic cameras, aerial photograph orientation equipment, onboard navigation instruments and mapping survey system

A71-40875

Aircraft heat viewer for underlying surfaces radiation properties, suggesting qualitative survey type thermal aerial photo combination with simultaneous radiometric measurements

A71-41300

AERIAL RECONNAISSANCE

Airborne IR linescan equipment for commercial aerial survey, discussing operational principle, temperature sensitivity, data processing and individual system components specifications

A71-42151

Application of aerial reconnaissance and remote sensor techniques to development of master engineering soil plans

[PB-199422] N71-35447
Research Flight Facility participation in BOMEX program and aircraft data inventory
[NOAA-TR-ERL-198-RFP-4] N71-35453

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Aerodynamic aspect ratio effects on drag and aircraft performance, noting span loading as major force on wing lifting function

A71-41246

Low speed wind tunnel measurement of induced drag characteristics of three 60 degree delta wings with different leading edge spanwise distributions

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FA-200XS experimental aircraft for investigating operational problems of STOL type aircraft

[NAL-TR-229] N71-34005

Calculations of aerodynamic properties of flexible wing grid using Reynolds number

[NT-21] N71-34006

Aerodynamic characteristics of lift fan installation for direct lift V/STOL aircraft

[NASA-TM-X-62086] N71-35204

Aerodynamic characteristics and flutter of T-tail aircraft configurations

[RAE-LIB-TRANS-1546] N71-35215

Aerodynamic and flight characteristics of supersonic aircraft and spacecraft motion in planetary gravitational fields

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KC-135 aircraft climb trajectories for optimum constant lift coefficient, range and fuel amount

A71-42834

Theoretical analysis of trailing edge blowing effects on circulation around airfoils based on iterative solutions with lift coefficients

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Calculations of helicopter airloads using lifting surface theory compared with experimental data

[AD-726717] N71-35226

AERODYNAMIC CONFIGURATIONS

Lifting configurations unsteady air loads prediction, investigating loading singularities in linearized potential theory

A71-42832

Aerodynamic characteristics and flutter of T-tail aircraft configurations

[RAE-LIB-TRANS-1546] N71-35215

Draft designing of vertical takeoff and landing aircraft

[AD-726572] N71-35219

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Fluctuating aerodynamic force measurement on stationary circular cylinder spanning wind tunnel, using direct method without support interference

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A71-40508

Calculated values of air forces on oscillating thin wings obtained by linearized potential flow

[AGARD-R-583-71] N71-35198

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Drooped wing tip effects on trailing vortex sheet structure and position on spanwise load distribution determination by vortex lattice theory

A71-40493

Lifting configurations unsteady air loads prediction, investigating loading singularities in linearized potential theory

A71-42832

AERODYNAMIC NOISE

Propeller vortex noise analysis by on-line 1/3

AERODYNAMIC STABILITY

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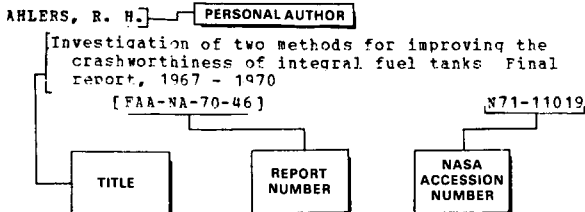
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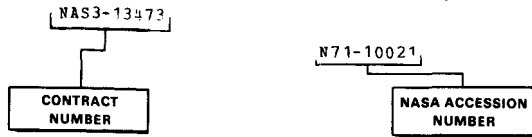
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